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THE

CAUSES, SYMPTOMS AND TREATMENT OF BURDWAN FEVER.

THE

CAUSES, SYMPTOMS AND TREATMENT

OF

BURDWAN FEVER,

OR

THE EPIDEMIC FEVER OF LOWER BENGAL.

" —— quæque ipse miserrima vidi,
Et quorum pars *magna* fui."

BY

GOPAUL CHUNDER ROY, M.D. Glasgow, F.R.C.S. London (exam.)

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THE BURDWAN FEVER.

1.—Causes.

THE devastation of the Epidemic has a very sad tale to tell (1875). Countries that once smiled with peace, health, and prosperity, have been turned into hot-beds of disease, misery, and death. Villages that once rang with the cheerful, merry tone of healthful infants, now resound with loud wailings and lamentations. Huts, which offered too little space for their occupants, are left without a tenant. The skulls of human beings now strew the fields at every few yards' distance. And this deplorable condition has come on and is continuing in defiance of the strenuous effort of the Government to limit its area of devastations. Clever brains have been employed in the solution of the problem, as how best to meet the foe in the face and stop its onward march; experiences and observations of Special Commissions have been called upon to solve the nature of the disease and its pro-

bable source of origin. But after all, the phenomena of nature have remained a "mystery" up to the present day and a sealed book to the eyes of mortals. The fell disease has mocked every human effort, and absorbed in its powerful grasp, day by day and inch by inch, every blessed spot which once used to be prized for its salubrity.

To trace the course of this disease will be a very interesting task. Some fifty years ago, in 1824, it made its appearance in Jessore, and afterwards in Nuddea, in 1856. The depopulation it caused at Oola first created alarm and drew public notice. Four years after, it extended itself into the district of Hughly and encroached upon Kanchrapara. Here it raged vehemently, and spread into Halishahar, Tribeni, Culna, and Guptipara in succession. Whilst it was making onward progress to the west, both the banks of the Hughly became affected, and the villages on either side of it up and down simultaneously presented one melancholy scene. From Tribeni it passed into Mugra, and thence to Panduah in 1862. Here it seemed to divide itself into two courses. The one, following a steady north-westerly route along the railway line to Mamari, reached Burdwan in 1869. The other branched off to Dwarbasini south-west, and appeared at Parambo and Shabazar, where it com-

mitted dreadful havoc. Overleaping an extent of territory not less than twenty square miles in area, it broke out next year at Coomurgunge, followed by an outbreak at Jehanabad in 1864. From Parambo and Shabazar it proceeded north-west by the eastern bank of the Damudar to Jamalpore and Selimabad, where it appeared in 1869. Thence it spread in a northerly direction and met the first course at Mamari. Thus the whole district became one continuous scene of disease, and for some time the fever hovered round the eastern bank till in two years more it crossed over to Sreekristopore and Jotseram. Now from Jehanabad, as from a common centre, it spread northwards to Chandoor, Bulchand, Akloky; westwards to Goghat, Kamarpookur as far as Kotulpore; eastwards to Mayapore, Krishnanagore, and southwards to Bally and Hajeepore. The northern course spread into the villages higher up till it was joined by the southward extension of the disease from Burdwan. In the neighbourhood of Burdwan its outbreak was simultaneous, and no history of priority or lateness can be made out from the statement of the villagers. It has since spread to Boodbood, Munglecote, Cutwa, and latterly has shown itself in its worst form in some of the villages of Beerbhoom and Midnapoor.

It will assist us much in our future inquiry to

trace once for all the physical geography of the Delta of the Ganges and the topography of Lower Bengal with reference to its rivers and canals. The whole of Lower Bengal is situated on the Delta of the Ganges, which consists of numerous streams and branches that cut up the land in a network. Here empty also the Padma, the Brahmaputra, the Damudar, the Rupnarayan, &c., after a long winding course, washing several tracts of country of which they are virtually the drainage channels. In the rainy season some of them bring down volumes of water in which a large quantity of earthy matter is suspended. It is said that a glass of water taken out at this time of the year contains about one part of mud in four. "The violence of the tropical rains and the fineness of the alluvial particles in Bengal cause the waters of the Ganges to be charged with foreign matter to an extent wholly unequalled by any large European river during the greatest floods. The Ganges frequently sweeps down large islands, and Colebrooke relates examples of the rapid filling up of some branches of the river and the excavation of new channels where the number of square miles of soil removed in a short time is astonishing, the column of earth being 114 ft. high. Forty square miles are mentioned as having been carried away in one district in the course of a few years. If we com-

pare the proportion of mud, as given by Rennel; with his computation of the quantity of water discharged, very striking results are obtained. If it were true that the Ganges in the flood season contained one part in four of mud, we shall then be obliged to suppose that there passes down every four days a quantity of mud equal in volume to the water which is discharged in the course of twenty-four hours. If the mud be assumed to be equal to one-half of the sp. gr. of granite, the weight of matter daily carried down in the flood seasons would be equal to seventy-four times the weight of the great pyramid of Egypt."

The swelling of the rivers in the rainy seasons and the overflowing of their banks form a characteristic feature of the rivers of Bengal. On account of this inundation the countries immediately bordering the banks are elevated more and more with deposit of alluvial sediment, and are on a considerably higher level than the inland plains for some distance. This slope from the river to the plains should be borne in mind in connection with the question of drainage of the villages. The width of the rivers increases in proportion to their proximity to the ocean. A small rivulet expands into a wide stream as it rolls on to empty its water into the neighbouring sea. In proportion to its expansion, the rapidity of its current gets lessened

and the deposit of fragments of stone and mud at its mouth is the result. Thus great changes take place in the Delta of a river by the prolongation of land and encroachment upon the sea by the formation of sand banks, by the filling up and silting of its bed, by evacuation of the bed of the river from one portion, and the opening out of a new channel in the other. These changes are more prone to occur in the mouths of the streams that are fed by the surface washings of the villages in the rainy season, than in those that are fed by the melting of snow. Although most of these rivers get dried and their beds silted up after the rains, yet at the next rainy season they are opened out afresh by the force of the current, and afford the same facility to the drainage of villages. Circumstances might, however, so happen as to offer material impediment to the discharge of this drainage water by the narrowing of the mouth of each outlet caused by the firm setting of the deposit.

The effect of the inundation is partly advantageous and partly injurious to the soil. When this water does not stand long in the plains, but is swiftly carried away by the khals which are the feeders of the larger streams, it adds to the fertility of the land by deposits of silt. Besides, it flushes the land and is a great purifying agency. It replenishes the tanks and carries away the aquatic

vegetation. But when it is allowed to stagnate long, it turns the plains into unproductive marshes, which change is still more characteristic if the water of inundation holds suspended in it, as it usually does, a quantity of sand. This stagnation of water impregnates the soil with moisture and favours excessive growth of vegetation.

The soil of Bengal consists mostly of a mixture of sand and clay in different proportions. The superficial stratum contains a preponderance of silica, which in some places forms the entire bulk. The stratum deeper down consists of tenacious clay of different degrees of depth, which is very glutinous and retentive of moisture. The water percolates through this very tardily unless the clay is mixed up with a large quantity of sand, which allows filtration through its interstices. Still farther down the sandy permeable layer is met with. In digging a well, generally the shaft must be sunk to a depth of 16 ft. before any water can be obtained. Sometimes water is reached more superficially, but at other times a good depth has to be dug into. The soil, consisting of salts of potash, lime, alumina, silica and organic matter, is peculiarly favourable to vegetable growth. As mentioned above, water percolates through this soil very slowly, and it can be well understood that, with a heavy rainfall in Bengal, if there exists

any impediment to the superficial drainage, the water will slowly sink in and impregnate the soil with dampness. The greater the depth of this stratum of clay the more effective will the impediment prove itself.

The towns and villages in Bengal are generally built on an elevated piece of ground which slopes towards the fields. They consist of an aggregation of huts with narrow streets and by-lanes. The mud, for the construction of huts, is generally dug out of a portion of land facing the intended dwelling. The economical habits of the Hindu prompt him to leave the pit thus formed unfilled up, which the surface washings of the rainy season convert into a water reservoir used for all household purposes. Here are washed and emptied all the refuse of the house, here is formed a convenient tank for bathing for the zenana, and from this polluted source, water for cooking, if not for drinking, is in most cases supplied. This tank is made to serve as a drainage reservoir of the neighbourhood, and receives surface washings of the rainy season. It is seldom that its proprietor invests money to clear its bottom, which in time becomes filled up with stinking mud. The water of it becomes so obnoxious as to become unfit for any purpose. The setting of the layer of mud materially obstructs the flow of subsoil water.

Besides these tanks which form the standing drainage reservoirs, there are running streams or khals which carry away the surplus water to the neighbouring fields or rivers. These khals are numerous, and correspond one for each village; some are even navigable at one end, and pass by the name of Nuddee, as the Kana Nudee, Sarswati khal, &c. Were it not for their agency, the places far removed from the river bank, would have been uninhabitable and unproductive from the extent of water that would have deluged their surfaces. The khals sometimes lead into low-lying tracts where, in the absence of an outlet, the ground remains under water throughout the year. These marshes, Jullas as they are called, are not numerous, and generally they have some sort of communication with a neighbouring stream. But it is not the inland places alone that require the agency of the khals for their drainage. For, owing to the condition previously mentioned, viz., the height of the villages being greater towards the river and their slope away from it, these also do not discharge their water into the river direct, but the water will have to be carried into it through the same intermediate channels. It will thus be seen how useful these natural drainage channels are for the integrity of the villages; for any interference with them will seriously upset the

balance of health of the villages of which they are the drainage outlets.

I have already said that the villages stand higher than the surrounding fields which separate one from the other. The extent of the fields is three or four times greater than the superficial area of the villages. In process of time every bit of that land has been brought under rice cultivation, so that the rice-fields present an uninterrupted view for miles around in the harvest season. It is the peculiar nature of the crop that the field should remain at least one foot under water before a good harvest can be expected. This water is prevented from flowing out by *als* or bunds that bound the field of every individual peasant. Assuming eighty inches as the amount of rainfall in one season, more than one-seventh of it has no outlet and is allowed to saturate the ground. This shallow sheet of water, spread over miles and miles, must necessarily affect the hygrometric state of the atmosphere and cause subsoil dampness. Besides, the decomposition of the stumps of rice-stalk, left after reaping the harvest, ought to be a fruitful cause of unhealthiness. Accordingly we observe Bengal enjoying the unenviable notoriety of being the hot-bed of fever, which is ever endemic, and rages with peculiar violence in that season of the year when the sub-

sidence of the water from the face of the earth affords greater facility to decomposition.

After these preliminary observations, we shall be in a better position to find out for ourselves the causes that have been in operation to bring about the present state of unhealthiness. The public are too much given to the train of thought that the cause of malaria must be a new agency, or at least one that was not at all in operation previous to the present outbreak, as if all causes are followed immediately by their respective results. They discard any view or theory if it assumes a cause that has been in existence for some time past. Thus if one tries to show that the soil is badly drained, the sceptic is ready with his argument that the same drainage operations had existed from the earliest date of his recollection. Again, if one points out that the ponds and the rice-fields are injurious, he will be equally disbelieved, since it would be urged they are of no less than fifty years' standing. Thus inquirers are led to unravel the mystery in the unknown phenomena of the celestial world, or seek the aid of electricity in the solution of all difficult problems. We forget that there is in Nature, pervading all her phenomena, the principle of toleration. An action might pass as innocuous as long as it is within this limited

bound, but directly that limit is overreached, a manifestation of disagreeable symptoms shows the reluctance on her part to pass it without notice. A glutton may indulge himself in his pleasant repasts for years and years without coming to grief, till at last a stage will be arrived at when the digestion will become impaired, and an obstinate diarrhœa will bring his blissful existence to an end. A drunkard may have his dram with impunity, but the cumulative effect of it will show itself subsequently in a sudden attack of delirium tremens. Instances like these might be multiplied to show that we need not rack our brains to find out an unknown agency for the explanation of the fever, but bearing in mind that line of argument, it will be easy to fix on some, out of "hundred and one causes," that have made Bengal a habitat of Malarious fever. We will presently show that it is the Endemic disease which has now assumed the virulence and spreading character of an *Epidemic*. The causes of this epidemicity we will discuss afterwards, when we have done with the mention of those that primarily engrafted the disease on the land.

Under these are included—(A) seasonal peculiarities, as variations of temperature and moisture, (B) want of sanitary arrangements in Bengal villages, and (C) dampness of soil. Other causes are assumed

to explain the spread of it, as (D) over-population and poverty, (E) contagion, and (F) epidemic influence.

(A) Dr. Saunders attributes the generation of fever chiefly and solely to seasonal influence. "The land in Bengal is partly submerged during the rainy season, and there is excessive wetness of the soil everywhere: but the sky during the monsoon months continues to be overcast, the necessary consequence of which is that very slight evaporation from the surface takes place, the diurnal variations in the temperature being unimportant. But when the sky clears in the month of September, or, in some years, in October, and the land has been more or less drained of the surplusage of water in the rice-plains of Bengal, then very rapid evaporation goes on from the surface, the atmosphere becomes surcharged with moisture, and, with the advanced season of the year, the daily range of the thermometer varies from 18 to 25 degrees." It is the continuance of these conditions which excites an enfeebled state of the system, and prostrates large masses of the community with disease, in this season of the year. Most of these poor creatures have to labour in the open air and exposed to a temperature of 140° in the sun's rays during the working hours of the day, the early morning temperature being as low as 60°. These variations of temperature and

variations in the hygrometric condition of the air, act injuriously upon the impoverished, half-clad and underfed inhabitants, and prove trying to their constitutions.

In support of his argument Dr. Saunders gives the degrees of variation of temperature and moisture in the different months of the year, the sum and substance of which may be taken to be the following:—

The variation of temperature in June is 8·1, in July 5·6, in August 6, in September 6·4, in October 8·6, in November 14·7, in December 16·3, in January and February 16·9, in March 16·5, in April 15·2, in May 12·9.

Range of moisture in June ·2, in July ·14, August ·15, in September ·17, in October ·35, in November ·3, in December ·32, in January ·32, in February ·37, in March ·4, in April ·36, in May ·3.

Hence it will be seen that the range of temperature is progessively on the increase from October till the maximum is reached in February, when it again begins to decline. The hygrometric condition also varies, and the range is greater from October till March, when the variation reaches its height. Both these conditions therefore are most marked, and must exert their baneful influence with greater certainty in the month of February, when the range of temperature is

great and the quantity of moisture existing in the air is very variable at different times of the day. But is this in harmony with the actual condition of health of the people? The January and February months in Bengal, prior to the appearance of the Epidemic, always showed a small number of fever cases, and, even in this unhealthy time, improvement begins to manifest itself directly the month of February is reached. October and November are, in fact, the most unhealthy months with reference to fever, when, according to the Hindu proverb, the eight portals of death are open to receive the departed mortals. Yet according to the table above given, these months do not occupy the foremost place. Dr. Saunders places some stress on the fact that these high ranges must be associated with actual intense cold and not with continuous warmth. Even then January ought to be the fever-month instead of October, which last in Bengal is scarcely reckoned amongst the winter months.

(B) Bengal villages are noted for want of sanitation and cleanliness, and the habits of the people tend to make them more filthy and fruitful hot-beds of disease. The arrangement of the huts in one block prevents ventilation and purification of air. Besides, the rooms are low and are not provided with a sufficient number of windows

for perflation of air. The floors are damp, and perhaps an only mat forms all the necessary furniture of a peasant's cottage. Close to his door are tied the bullocks, the companions of his toil, whose excreta are allowed to collect in heaps and rot for the whole year to supply him with manure for his next harvest. Careless and indifferent, he does not mind about cleanliness, and the whole surrounding area is allowed to remain fallow, and gets overgrown with rank vegetation. Cesspools, pits, and marshes exist at every step, and nobody thinks it his business either to fill them up or cut out a drain for outlet. His poverty does not allow him to clothe himself sufficiently, and thus scantily clad, he is exposed to all variations of temperature; he is engaged the whole day in his fields from the beginning of the rainy season to the end of winter, ploughing, sowing, mowing, reaping, thrashing, &c., and working for hours and hours whilst wading ankle-deep in mud. His diet is meagre and not sufficiently nutritious, and sometimes he is content to have a single meal a day. The disposal of the dead is by cremation in the case of Hindus, and by burial in the case of Mahometans; cremation takes place by the side of a stream or pond; and burial is had recourse to either in the compound or close by. No place is considered more suited

for easing one's self than the bank of a river or the side of a tank, from which perhaps the village draws its whole water-supply. When all these conditions, with a number of other minor ones, are placed before the reader, should he wonder to be told that disease has broken out in the locality and is carrying away numbers of victims? Why, sanitary science will be a mockery, if better health and lower mortality could have been compatible with the deplorable condition that I have described. But when on the other side of the scale we place the villages that are exempt from this pestilence, though they enjoy equal advantage as regards sanitary measures, our belief on this as the *originator* of the disaster becomes much shaken. It can hardly be denied that the greatest mortality has been in the most populous villages, where there has been a greater accumulation of filth and dirt, and those have been more slow to recover where jungles, bamboo topes, cesspits and tanks abound. The part, which want of sanitation has played in the Epidemic, has therefore greater reference to the predisposition and aggravation of the disease than to its immediate causation.

Out of these headings of general unsanitation two have been more signalised than the rest, viz., jungles and bad water. When the fever first

showed itself in the district of Hughly, the exuberance of vegetation was pointedly marked out as the chief cause of unhealthiness. With eager desire to nip the growing evil in the bud a wholesale order was given to free the villages of vegetation. The mania was carried to such an extreme that mangoe topes and other fruit trees were cut down, much to the distress and loss of the owners. It is not large trees, but the perennial shrubs which die every year and rot and decompose on the ground, that are objectionable. The existence of excessive jungle undoubtedly gives rise to a peculiar smell which can be perceived directly on entering a jungly village from an open field. The bamboo sheds so many leaves that a cluster of them will 'carpet' the ground thickly to some distance around. It has been argued that jungles and fever have not proved themselves commensurate, and, on the other hand, that jungle-free villages have suffered as much as the rest. My general experience does not tally with the opinion herein expressed, as, with a very few exceptions, I can safely assert that both bear some degree of relationship. Of course I do not include under jungles any thick plantation of large trees, but only rank growth of wild shrubs and brush-wood. Jungles are the indication of a moist condition of the soil, with which they bear a certain rela-

tion. Excessive jungle implies supersaturation of the soil with moisture, which, as we will presently observe, is itself a fruitful cause of disease. Villages bordering the river side are more jungly as a rule, than those far removed to the interior. In some dry rocky soils of the North-Western and Central Provinces scarcely a shrub grows, and in those localities enlarged spleen is a medical curiosity. The places on the right bank of the Damudar, as Shadeepore, Jotseram Sreekristopore, are very jungly and the virulence of the fever was proportionate, whilst others on the same side and more inland with less jungles, as Sankta, Dhamuaree, Soobuldah, Oochalun, suffered less. Some have specified particular classes of jungle as more objectionable, but, with the restriction I have given above, I am not partial to any variety. The growth of Belatee Bharenda is by some looked upon as very significant, but if this plant has grown more abundantly of late than any other, it is simply because it is more tenacious of vitality.

The belief is common that bad water is the source of local unhealthiness, and some go the length of asserting that malaria is due simply to an impure water supply. Whether there is any particular ingredient in this bad water which is productive of malaria I am not aware of; nor would I give it more credit than, that by

deteriorating the general standard of health, it paves the way for all endemic or epidemic diseases. One broad fact militates strongly against this theory. The places where malaria first showed itself are those bordering the river side, and the progress of the disease in the Jehanabad circle will show that it spread inland from the banks of the Damudar and the Darkessur. Now these are the very places that for eight months in the year enjoy the benefit of pure wholesome river water. The villages on the Hughly, as Kanchrapara, Halishahar, Tribeni, Guptipara, are all on the banks of the river. The water here is as pure as that of Barrackpore, at which spot the water supply for Calcutta is drawn, and which we may take as our standard for the sake of convenience, and yet they fared worst in the visitation of the epidemic. It is but fair to mention that those villages which I will presently point out as having suffered least are those that enjoyed, along with other advantages, a good water-supply. Dr. Smith believes that "where there is an ample and pure supply of water there is as a rule comparatively little fever." But he adds, "instances of exceptional character where people drink good tank-water yet great mortality has occurred. On the other hand, at Polashee on the Koontee the people, having no tanks near them, drink the water of

the old half-dried-up river, a source by no means inviting, and yet it is a fact that the place does not seem ever to have been particularly unhealthy, and that mortality of late years has undoubtedly been low." The bunding up of the mouths of some rivers and canals has undoubtedly deteriorated the water-supply of the district through which they passed. For according to the Hindu idea of looking upon every running stream as pure and holy, the water-supply is chiefly drawn from such sources, and the integrity of tanks in those villages is consequently never preserved. The sudden cutting off of that supply will sooner or later show itself on the already depraved health of the inhabitants. This is just the condition of the villages through which the Kana Nudee used to flow, the closing of which, opposite Selimabad, has given rise to loud outcries on the part of the villagers, who justly attribute their sickly state of health to that stoppage. Whoever has personally witnessed the bed of the Kana Nudee, from Haralla for some miles down, will fully sympathize with them in this belief. In places where crystal water was once procurable, shallow pools have been left overgrown with decaying vegetation and teeming with animalcules.* The other evil effects

* We are glad to notice that since the above was written, Government have undertaken to commence operations at the point the Kana Nudee took its departure from the Damudar, with a view to open out its channel.

of bunds thrown across water-outlets will be dwelt upon under the next heading of causation.

(c) Medical opinion has been almost unanimous in attributing the present unhealthy state of the country to dampness of soil and increased subsoil moisture. The evidence on this point, however, is purely an inferential one, for it must be borne in mind that when we speak of increased moisture, we have no previous data wherewith to make any comparison. No one knows what the subsoil water level of those districts was previous to the outbreak of the fever; but we base our conclusions on the following facts:—

1*st*.—That the fever is not persistent but varies in its severity with the change of season, beginning when the rainy season sets in, reaching its climax when the ground is thoroughly saturated, and gradually abating and remaining in abeyance when the powerful summer sun dries up the ground to cracks and fissures.

2*nd*.—It is more severe in the year attended with unusual rainfall.

3*rd*.—Comparative freedom of places situated within the zone of fever, which have everything in common with the rest, excepting an elevated site and dryness of soil. Although these facts are sufficiently significant, yet I must confess that personal inquiry from the villagers leads to no

definite result. Thus I have failed to elicit the opinion from their own observation that their soil has become more damp of late, or that the khals carry water more tardily than before. I have seen tanks dug in some of these fever-stricken places to the depth of 21 feet without reaching the water level; and Mr. Metcalfe records his experiment of a shaft sunk in the bed of the Banka River to the depth of 8 ft. without oozing of water from any side. But my own observation as well as that of Mr. Metcalfe was taken in summer when, as some writer wittily remarked, the soil is so dry that "we might as well expect to draw blood out of stone as water from a parched-up ground in that season."

Supposing the dampness of soil to be co-existent with malaria, the question remains to be solved, how has that dampness been induced? Several causes present themselves to our observation: (*a*) Naturally heavy and sometimes unnaturally heavy and unequal rain-falls, (*b*) Inundation, (*c*) Peculiarity of soil and its property of retaining moisture, (*d*) Existence of tanks and unreclaimed marshes and rice-fields, (*e*) Naturally defective drainage, (*f*) Obstructed drainage, either artificial, as by bunding up the course of water channels by dams, weirs, rail-roads, &c., or natural, as by alteration in the courses of rivers and silting up of their beds.

(*a*) No doubt, all these causes have been

operating to bring about the unhealthy condition, and we cannot apportion the share which each has in its generation. A peculiarity of climate in the tropics is the constant down-pour of rain in certain seasons of the year, the rainfall sometimes amounting from 80 to 100 inches. There should be good slope and efficient drains to remove this excess of water, which must otherwise sink in, or collect in stagnant pools. The villages have never had any surface drains, but, as has been observed in the preceding pages, the water obeying the natural law of finding its level, makes its way out. The constancy of the action, repeated year after year, works out a channel or khal which ends by discharging into some navigable stream. This natural drainage is always insufficient for a plain tract of country without any undulation for several hundred miles in extent. Artificial drainage is strongly indicated, in absence of which the soil remains permanently damp, and malaria becomes endemic.

(*b*) The effects of inundation I have already pointed out before. It is the slow subsidence of water from the face of the villages that acts injuriously on the health, otherwise experience shows that the flushing of the villages has the salutary influence of scouring the ground and sweeping away impurities. The inundation after a heavy rainfall is known to give rise to increase of fever.

(*c*) The peculiarity of soil helps in some degree to impregnate itself with moisture. The superficial portion being a mixture of clay with sand in excess, the water rapidly percolates through it, till it meets with an obstacle in the adhesive alluvial stratum. The greater the thickness of this layer the more prolonged will the obstruction be and the saturation more complete. Under such circumstances, the generation of malaria will be but a question of time. I do not think this point has received the due attention it deserves, and as yet engineering observations are wanting to establish the extent of this condition with the proportionate amount of unhealthiness in the land.

(*d*) No Bengal village can be found where tanks are not found at every few yards' distance; unless the structure of the soil is so sandy as to offer material obstacles to their existence. Thus at Kanchrapara no tank or even a well can exist long without being filled up by the falling in of the sides. The tanks that have no raised earthen mounds on their banks are practically the drainage reservoirs, and draw into them the drainage water. Having no outlet they are virtually deep obstructed drains. When deep they draw into them subsoil moisture, but the constant deposit of ground-washings so fills up their beds and closes their interstices that they cease to act as such. It is a

known fact that the bed of an old dry tank will not fill in by percolation of water unless it is dug out a few feet deeper; that whereas water will begin to ooze after a depth of 15 ft. is dug into a fresh soil, the beds of the old tank must be dug deeper than 20 ft. before water will make its appearance. This obstruction to free subterranean current will have a tendency to make the soil water-logged. The houses bordering the tanks are damp and are looked upon as unhealthy.

From a very remote period low marshy soils have been noted as hot-beds of malaria. The Campagna of Rome and the plains of Algeria may be cited as notorious examples. From time immemorial they have been justly dreaded for their unhealthiness. We have two constant conditions existing in the marshes, namely, moisture and decaying vegetation. Hence moisture and decaying vegetation, wherever observed, have, from a very ancient date, become synonymous with malaria. That these two factors are the principal unhealthy agents, has been shown by positive proofs, for by eliminating them from the soil by drainage and proper cultivation, a once unhealthy spot may be converted into a healthy one. Such has been the case with the Roman marshes, and such also is the history of improvement of Algeria, as is testified by the Report of

Royal Commission 1870. Such is also the case with the Port Canning Reclamation land which, at its first occupation, was found nearly uninhabitable, whilst a few years of sanitary work have built a town, where formerly tigers and wild beasts prowled and roamed with undisturbed felicity. We have in Bengal marshes which go by the name of jullas, and the saucer-shaped depression existing between Hughly and Burdwan cannot but have a prejudicial influence.

The area of these natural marshes is utterly insignificant compared to the area that has been virtually turned into a marsh by the extensive cultivation of rice in Lower Bengal. The increasing population must have caused an increasing demand for their staple article of food, which was still more in requisition from the increased export of grain which has received unprecedented encouragement of late. This has led every peasant to engage himself in its production as the sure means of profit, and every bit of marginal land that formerly remained fallow has now been brought under the plough. So much has rice cultivation increased that even in the hearts of villages patches of land have not been spared to yield a crop. Hence we have moisture and vegetable decomposition going on to an extent which has no parallel in any other country. The prox-

imity of rice-fields is always considered unhealthy on that account, and a province with extensive rice cultivation is much below par in its standard of health. Barcelona in Venezuela and several places in the West Indies were so malarious during the harvest season that the people had to desert the neighbourhood for six months to escape its deadly influence. Orders were passed forbidding any cultivation of rice for some distance from the confines of inhabited land. Jessore, Burrisal, and other places in Eastern Bengal enjoyed the unenviable notoriety of being at all times the habitat of fever, whilst the Hughly and Burdwan districts were in the height of their blissful state of healthiness. Those are the very districts that have at all times supplied not only the whole of Bengal but other countries with their produce of rice, and how far the endemicity of fever in those districts was the effect of that extensive rice cultivation further observations should corroborate. For the present, the following facts may be adduced in proof of the supposition:—1*st.*—That with the increase of rice cultivation in the districts of Hughly and Burdwan the fever has made its appearance in these places. 2*nd.*—That the fever continues as long as the fields are under water from September to January, and begins to abate just after the harvest is reaped and the fields

dry up. Rice cultivation is objectionable not *per se* but on account of moisture and vegetable decomposition that are the necessary atttendants on such conditions. It has been objected to by some on the ground that other places have suffered that have no contiguous rice-fields, as if rice-fields alone were obnoxious to health. Those who advance such objections, evidently forget that the cultivation of rice necessitates a certain violation of sanitary principles which could be also brought about by a hundred other agencies. That rice cultivation is one of the very powerful means of rendering the soil humid, can be satisfactorily made out by inspection of the country in the fever season, when it will be found that though the villages are dry, and their water drained off, there is stagnation in every field, the extent of whose surface in square miles is, at the lowest estimate, three times as great as that of the villages themselves.

(*e*) I have mentioned before that a great part of the drainage water passes into the tanks and the rest flows out into the fields and thence into the khals, by which channels it is ultimately disposed of. All these standing drainage reservoirs are defective and insufficient. Defective, because being stationary and not having any outlet, they must necessarily impregnate the surrounding

country with subsoil moisture. A running drain is undoubtedly preferable to a stagnant one, and is more effective in its operation. The only running drain that carries the rain-water is the khal that skirts along the border of the village. Its breadth and depth are in most cases quite insufficient for the volume of water that has to be removed. Besides, the obstruction the water meets with in passing out of every field is too great a hindrance. Supposing the khals had been deep and broad enough for drainage purposes, and their channels down to their ultimate destination patent throughout without any obstruction or silting up of river, would the drainage of fields and villages, I ask, be perfect? Would not the bunding of the individual fields keep in the water and prevent its flowing out? I have witnessed the ponding of water in patches of fields very close to the water outlet, and I am at a loss to find out any means for obviating this evil, unless a thorough system of irrigation is introduced, making it unnecessary for the peasant to retain water in his field for the supply of the whole season. These preventive measures will be dwelt upon hereafter.

(*f*) Under the heading of drainage, great stress has been laid on the obstruction which has been offered to the khals artificially by embankments thrown across them, or naturally by the natural

deltaic influence interfering very much with the capacity and patency of a stream. Artificial obstruction is mainly caused by bund raised across the khal to retain water in its bed for agricultural and domestic purposes, or by the construction of a high earthen embankment round a village to prevent any damage from the inundation-water getting into it. I have personally investigated the instances of the former kind of obstruction met with in the Jehanabad subdivision which were pointedly marked out by the writer of "The Epidemic Fever in Bengal" as having been the immediate cause of the outbreak of fever. As the pamphlet carried with it an appearance of authority and conviction, and created a sensation among those interested in the subject, we give them in the author's own words:—"The subdivisional town of Jehanabad is situated on the eastern bank of the Dwarkessur River. Its drainage, following the laws we have already explained, flowed into the paddy fields lying to the north-east of the town, whence a part of it used to fall into the Kana Nudee. But the major portion, after passing over the paddy fields, collected in the Byra Julla and thence discharged into the Kana Nudee through Gurbari khal. This khal, pursuing a serpentine course, traverses a large tract of country, and, receiving the drainage of a large number of other

villages besides that of Jehanabad, opens into the Kana Nudee at a place called Gopinathpore. Its mouth was closed by the Zemindar through whose property it passed in the Bengali year 1273 (A.D. 1866 and 1867) for the purpose of retaining water on the rice-fields, which are very high and from which the monsoon water ran off into the Khal. This closure helped to keep the khal full, and at the same time rendered it incapable of receiving the drainage from the paddy fields, and the latter in their turn failed to draw water from the villages of which they were the drainage media. This lock-up was followed by the outbreak of an epidemic almost simultaneously in all the villages of which the khal was the drainage outlet;—in a mitigated form in the year immediately succeeding the one in which the khal was closed and virulently the year after." (Pp. 15, 16.)

Again: "In the same tract of country, and for precisely the same purpose, another stream, called the Koko Nudee, which was the drainage channel of a large number of villages and which likewise emptied itself into the Kana Nudee, was similarly closed at its mouth at Dhurrumpota in the same year, viz., 1866-67, and the same was followed shortly after by an outbreak of epidemic fever in a number of villages, &c. We should here mention that the cross dam over this khal is provided

with an apology for a sluice which is so adjusted as to let out the water only when the khal is full to overflowing and when the crop of the adjoining fields is likely to suffer from excess of moisture. This of course does not help the drainage of the villages, inasmuch as the whole of this tract is very high and the villages situated therein are not much higher than the surrounding paddy fields. The consequence is that the khals and the paddy fields being full do not draw the drainage from the adjoining villages."

The authenticity and correctness of these remarks have been shaken by the following result of a personal investigation recorded on the 13th May, 1873. "I paid a visit this afternoon to the bund at Paharpore (close to Gopinathpore). It is 30 ft. broad at its base and about 15 ft. in altitude, and extends right across the Gurbari khal very close to the point where it discharges its water into the Kana Nudee. The villagers, invited to give information on the point, told me that the bund had been in existence about twenty years ago and remained in working order for eight years, shutting in the water completely. In the event of an inundation, they used to have a side-cutting to let out the excess of water. This always retained water in the khal and kept it full even in summer. After eight years' satisfactory working a portion of

it was washed away by heavy rain. The gap remained open for four years, producing much scarcity of crop in absence of water, until in 1866-67 it was reconstructed by the zemindar Baboo Joy Kissen Mookerjee. Sufficient earth was thrown over the remnant of the original bund so as to raise it 2 ft. higher than the former level; but the next year's flood washed away the northern extremity of the embankment, causing a breach about 18 ft. wide, spacious enough for a full current to pass with freedom. The people suffered much from want of good water both for drinking and agricultural purposes, there being no drinkable water in the village! So virtually no obstruction existed for five years previous to the outbreak of the epidemic, and at the time the fever did make its appearance the obstruction was no longer in existence and the khal was patent throughout and remained so up to June, 1873, when at the urgent request of the inhabitants the bund was reconstructed, with a side channel higher up for the drainage of surplus of water. I am happy to state that the reconstruction of it last year before the rains has not materially affected the health of the district which, if at all, has shown signs of improvement of late. In reference to the para. on the Koko Nudee, I submit the following fact:—The 13th May, 1873, I visited the Koko Nudee and the bund. The

khal or stream has its source at Sonagachee and ends at Dhurmopota by joining with the Kana Nudee. The present bund was constructed about eight years ago and the fever has broken out only three years since. It was in perfect condition for seven years, but gave way only last year through pressure of water. The engineering mechanism displayed in its construction was such as to preclude any idea of obstruction, for whilst it retained a certain quantity of water in its bed, it always let out, by a side opening above a certain level, the excess of drainage water. The outflow was constant and efficient enough, inasmuch as the water in the khal never overflowed its banks as long as the bund was in perfect condition, whilst it retained water enough for agricultural purposes. Now before the construction of the present cross dam, about thirteen years ago, there was a *pucca* wall with a sluice to let out the excess of water. At times the pressure of the water behind was so great as to make it impossible for the valve to be raised, when the water would flow over it and find its exit. In three years the whole work came to pieces, when the present mechanism was substituted. But antecedent to this again, from a time beyond recollection, the people were in the habit of bunding up the mouth by earthen mounds, which were as often washed away on account of

the dead opposition they offered. Thus we find three systems of embankments resorted to at different times. The first or old system in which a dead barrier was offered and as often washed away. The second improvement consisted of a *pucca* wall with a sluice to let out occasionally the excess of water. And the third or the last one which had the advantage of a continuous outflow. Now, which of the three offered the most impediment to drainage we need not take time to consider, and yet it was during the operation of the last method (i. e. only three years ago) when the flow was so constant and the obstruction so little that the banks never overflowed, that the fever first broke out."

The bunding up of the Kana Nudee at its mouth had a different motive however. Its object was not to retain water in the khal but to prevent its entering and inundating the tract in its vicinity. It allowed the beds of the khals to carry on the drainage uninterruptedly as before, but in the absence of the deepening effect of a running stream the bed of the Kana Nudee became partially filled up. One mouth of the Nudee is open,—that which joins the Saraswati khal and towards which the drainage level inclines. The closure being at its other mouth, it can be presumed that the embankment has not so much injured the locality by

depriving it of its drainage agency, as by keeping the channel dry in that season of the year when there is no water to be carried away, it has damaged the health of the district by depriving it of a source of its good water-supply. Everywhere in its course the outcry of the villagers is bad water and scarcity of water, but I found very few attribute the fever to the obstruction and insufficient exit of the drainage.

In rainy weather I found the bed of the Kana Nudee containing water to the depth of 5 or 6 ft. which had drained into it from the adjacent villages. Since the above was written, the Government has been awakened to the necessity of opening out the channel and turning into it the water of the Damoodah. More than twenty years ago the bed of the Kana Nudee formed the original course of the river, but it was closed up opposite Selimabad to prevent the overflowing of its banks and causing damage to rail-roads that passed through its area. Its bed silted up next year, but the force of the current opened out for itself a fresh channel. The small stream that communicated with the Damoodah at this portion expanded into a wide river that flowed south-east through Amtah to discharge itself into the Hughly close to the point where the Roopanarain also empties itself. Thus the course of the main channel was turned.

Whilst one district was deprived of the agency of a running stream, another had the advantage and disadvantage of the same. If the closing of one channel be supposed te give rise to local unhealthiness, the substitution of another with similar conditions in another part of the country ought to be attended with corresponding improvement. But when after twenty years we fail to observe any such beneficial change, we are forced to the conclusion that the unhealthiness of the district forming both the present and past bed of the Damoodah is independent of deficient drainage. However, now that the Kana Nudee has been opened out anew the fact will be proved to demonstration by observing the health of the district through which it will flow.

The other cross-dams and weirs are raised for the purpose of fishery or to irrigate the fields in the dry season, but they are never undertaken before September when the water from the village has all drained off, and what remains in the khal is nothing compared to what had been discharged. To attempt to close a stream in the height of the rains with an earthen mound, the power of cohesion amongst whose particles is so feeble that the slightest moisture dissolves it, is to under-estimate the hydraulic force of a body of water. For, as yet I have not seen any earthen dam strong enough

to oppose the action of a sheet of running-water for any length of time without giving way to the pressure behind. In most of the Kutcha roads recently constructed I have seen water-courses so obstructed, in some instances with an apology for a culvert or none at all, but these roads give way to the continual pressure of water, wide breaches are thus made in the rainy season, at places which have to be crossed over by means of canoes and rafts. Thus the new road which passes from Jehanabad to Bally has five such breaches in the course of two miles. No doubt they did offer some impediment to drainage at the commencement, but if the outbreak of fever be attributed solely to their construction, now that the obstruction has given way, the fever ought to disappear along with the removal of the cause. But its persistence clearly indicates some cause more potent and more constant in its nature.

New roads in the subdivision of Jehanabad, to which my observations are chiefly confined, have not sprung up of late, excepting two or three kutcha roads running for short distances. As I have just remarked, the obstruction offered by them is not so wide-spread as to account for fever all over the country. Besides, the first appearance of the disease was at Kumargunge, a village situated on the southern bank of the

Dwarkessur and entirely beyond the influence of the roads that are on its northern side.

As for the agency of rail-roads in the production of the disease, one fact negatives the belief, namely, that the epidemic devastated "Oola" and other places prior to their construction, and that the places that suffered most are far beyond their influence. Thus Jehanabad is about twenty-eight miles from the nearest railway station, and yet it, with all its adjoining villages, suffered most in the late visitation. The unanimous opinions of the Engineers commissioned to report on the matter prove, "that there was no ponding up of water on the up as compared with the down stream side of embankments; that there is ample water-way through existing culverts; that as a rule, there is no difference in rice crops on the two sides, and lastly that there is no fixed relation between the unhealthiness of villages and their proximity to roads or railway embankments; that, consequently, such works cannot fairly be considered as sources of obstruction to drainage or the causes of local unhealthiness." However, Dr. Smith takes exception to the preceding remarks and says—"that although no ponding up of water may be conspicuous, an amount of subsoil stagnation may occur sufficient to be locally prejudicial to health; such an effect might be produced

whilst there was but a very slight difference in the levels of surface-water on the opposite sides of an embankment." The universal nature of the outbreak in Lower Bengal precludes the idea of its generation in local obstructions to drainage, which can only account for the outbreak in villages under their immediate influence, and certainly not in others, which own altogether different systems of khals and rivers. Nor has the fact been established that all the villages without exception have had their drainage obstructed likewise. This leads us to the discussion of the next heading of causation, *viz.*:—

(*g*) Alteration in the course of rivers and silting up of their mouths. On referring to the bed of the river Hughly it will be found, that for the last century it has deviated from its original course. Thus villages have been absorbed in its watery bed and new ones have sprung up where heavy-laden boats once sailed with impunity. The village of Kanchrapara, which was very severely visited by fever, has its old site in the bed of the river. I am myself a native of the place, and I was told by my parents, that about half a century ago our family dwelling house, that now stands on the very bank of the river, was the eastern-most boundary of the village. Similar reports will be told of Guptipara

and Santipur, where at present extensive sand-banks have been left indicative of the encroachment of the water and its subsequent subsidence. Analogous history also will be told of the Bhagirati, the Damudah and the Dwarkessur. In fact the encroachment on one bank and the retiring from the other form the characteristic feature of the rivers in India. This change is more perceptible at the mouth of the river than at its origin; hence the places on the former are more liable to change in their physical condition than the latter. Any obstruction at its mouth will necessarily cause the rising of the subsoil water-level in the immediate neighbourhood, which by gravitation will pass also to the villages adjacent. Thus year after year more places will come under the influence of dampness, and get in their turn desolated by fever. This view of the question gets some countenance from the fact of the slow spread of the Epidemic from one place to another, and to the places, bordering the river side, having been previously and more severely affected than those situated farther inland. But the manner of its subsequent subsidence does not lend any further support to this hypothesis. For whilst the country primarily affected begins to improve, new ones continue to be desolated, and this improvement cannot

be coexistent when both own a general drainage medium. Besides, the filling up of the mouths of rivers is an hypothesis not supported by actual experiment,—an hypothesis which is opposed to the fact that in the height of the flood of the Damudah rising from 15 to 20 ft. in the course of a night, the whole of that immense bulk of water is drained away in the course of twenty-four or forty-eight hours.

Whenever the waters recede and leave an extensive sandy tract, any khal that might have discharged its water at that point is partially or entirely obstructed at its point of outlet. Thus the Bagare khal, through which the drainage of Kanchrapara finds its exit into the river, has the sandbank just opposite to it, and how far this hindrance or the railways, which have been accredited with the result, are to be blamed for the local unhealthiness is not an easy matter to solve.

But as I have explained that whilst the river recedes from one bank it encroaches upon the land on the other, it may be presumed that the same obstruction does not exist on the opposite side, and yet when both of them are equally affected, as Tribeni and Kanchrapara, it makes the subject somewhat mysterious. In the sub-division of Jehanabad, Kumargunge was first

affected, and it was for some time that this bank had been giving away, yet there was scarcely any difference in the amount of fever between this and Akloky situated on the other side.

It is a recorded fact that some of the rivers have silted up. The Kana Nudee of Jehanabad was once as big a stream as the Dwarkessur, which here divided into two branches; one, passing through Chandur, Myapur and Khanakul, was continuous with the Rupnarain at Bukshee, and the other passed through Balee, and became a tributary to the Rupnarain some miles below Ghatal. The heavy flooding that took place some fifty years ago, threw up so much sand that its bed was filled up completely and was raised much higher than the original level. The course of the stream was altered, and the former bed was planted with mango-trees and cultivated for rice crops. The portion beyond the division now carries simply the drainage of the district to the Rupnarain and remains dry in the summer season. Dr. Dutt mentions the extinction of a channel called the Baluka, whose course he has traced for a distance of ten or fifteen miles from Burdwan. At Myapur the Ratnagar khal has dried up for upwards of a century which once kept up the communication between the Dwarkessur and the Moondeshary. Investigation on

this point would bring to light a host of other minor channels that have dried up from a period varying from twenty to one hundred years. Such a length of time has transpired since then and the outbreak of fever that one hesitates to assign more share to it than that its influence, if any, must be a slow one and not powerfully active. For directly after the closure of one channel the pent-up water makes for itself a second outlet and the difficulty is removed. Besides, in absence of any other reliable informatian, if we are to trust to the experience of the ignorant villagers, it should be mentioned that their belief is that the water flows in equally strong current and volume as it used to do of old, and that the existing rivers and khals are emptied after inundation as efficiently and quickly as they used to be some years back.

Thus whilst denying to each and all of the foregoing causes the credit of bringing about the present outbreak of fever in an Epidemic form, I admit that they are active enough to engraft it as endemic *of* the soil. They have been in operation for ages past, and the fever has co-existed with them. All investigations to establish some special change in them to account for the extra virulence of the poison have proved disappointing. Some of them no doubt have been

acting lately in an aggravated form, but they also fail to supply a general explanation. Thus with the advance of years sanitation has been neglected and more filth accumulated in the villages. The general causes of dampness have slowly and gradually increased, and the increasing rice cultivation in the Lower Bengal has added still more to exaggerate the evil. Yet something more is wanting to explain the explosive way in which the disease showed itself. This will lead us to the consideration of those causes which we term immediate or exciting.

First. Poverty, over-crowding and deficient vital energy. The Government of India, I believe, have partly subscribed to this view, originally promulgated by Col. Haig and supported by Dr. Saunders. It implies that endemic disease has become general not from any increased potency of 'malaria' but from diminished power of resistance in the constitution of the people, brought on by over-crowding, insufficient food and general poverty. To support the existence of this condition in society they had recourse to the doctrine of Malthus. For the benefit of general readers I will quote it as it has been briefly given in Mill's Political Economy.

"The power of multiplication inherent in all organic life may be regarded as infinite. There

is no one species of vegetable or animal which, if the earth were entirely abandoned to it and to the things on which it feeds, would not, in a small number of years, overspread every region of the globe of which the climate was compatible with its existence. The degree of possible rapidity is different in different orders of beings, but in all, it is sufficient for the earth to be very speedily filled up. There are many species of vegetables of which a single plant will produce in one year the germs of a thousand. If only two come to maturity, in 14 years the two will have multiplied to 16,000 and more. It is but a moderate case of fecundity in animals to be capable of quadrupling their numbers in a single year. If they do as much in half a century 10,000 will have swelled within two centuries to upwards of two millions and a half. The capacity of increase is necessarily in a geometrical progression, the numerical ratio alone is different. To this property of organized beings the human species forms no exception. Its power of increase is indefinite, and the actual multiplication would be extraordinarily rapid if the power were exercised to the utmost. The capacity of multiplication in the human species exceeds even this where the climate is good and early marriages usual. It is a very low estimate of the capacity of increase if we only assume that in a good sani-

tary condition of the people, each generation may be double the number of the generation which preceded it."—"Now as to the causes which keep the actual increase of mankind within limit. What prevents the population of hares and rabbits from overstocking the earth? No want of fecundity, but causes very different: many enemies and insufficient subsistence; not enough to eat and liability to being eaten. In the human race, which is not generally subject to the latter inconvenience, the equivalents for it are war and disease. If the multiplication of mankind proceeded only like that of the other animals, from a manner with theirs, the births would be as numerous as the physical constitution of the species admitted of, the population would be kept down by deaths. In a very backward state of society like that of many parts of Asia at present, population is kept down by actual starvation. The starvation does not take place in ordinary years but in seasons of scarcity, which in those states of society are much more frequent and more extreme than Europe is accustomed to. In these seasons actual want, or the maladies consequent on it, carry off numbers of population which, in a succession of favourable years, again expands to be again cruelly decimated."

Basing their theory on this fact of political

economy they have been led to look on the fever as a natural sequence brought on by overcrowding and ill-nourishment. That just before the epidemic cruelly ravaged the district of Hughly and Burdwan, the population had increased to a considerable extent, having been kept up by early marriage, which is a necessary institution of Hindu Society, both among the high and low classes, is a fact which cannot be gainsaid, especially when we take into account the previous salubrity of climate for a great portion of the year for which these districts were famous. Every villager will testify to the crowded population which "graced" every village before the wholesale illness was threatened. The evil effects of overcrowding show themselves only in families where the sanitary principle is violated, and it is not likely that every family should have been overstocked at the same time. Besides, the well-to-do classes and the European community were free from such culpable neglect. The lower classes spend most part of their time in out-door employments, and phthisis, which is most common under such conditions, is a rare disease in Bengal. Hence, whatever might be said in its favour as being a predisposing cause, certainly over-population cannot be assumed to have had any share in its immediate causation and spread. The second part of the doctrine points to gradual introduction

of poverty in society on account of increased multiplication of the race without any corresponding increase in its food-producing resources. It is very true that before the appearance of the Epidemic there was a semblance of prosperity all over the country. But that prosperity was limited to the upper few, and was not the lot of the peasant community which form the bulk of village population. The custom of leasing out lands for cultivation with no limited rate of rent, and the exorbitant demand of half its produce by the Zemindars, often leaves a small margin for the benefit of the cultivator, who has to cope at the same time with the disadvantage of general increase in the price of all domestic necessaries. Besides, the superseding of some native manufactures, such as cloths, &c., by foreign supply has greatly pauperised the resources of the working classes. It is pitiable to observe the condition to which competition has brought down the weavers that people mostly the sub-division of Jehanabad, and it is to be regretted that no sort of protection has been afforded to that honest body of workmen by putting a stop to unfair competition in the market. These are the classes of people on whom the brunt of the disease has fallen most severely. The introduction of manufacture in the jails is another instance of how the income of the working classes has been en-

croached upon. The facility of transport, now existing all over the country by the establishment of rail-roads, has raised the price of necessaries with the increasing demand. The combination of all these circumstances, together with the increase in the number of each household in the course of the last few years, more than counterbalanced the trifling gain which the peasant class enjoyed from the produce of their labour on account of the increased demand and exportation of rice for foreign supply. The daily nourishment of the poor people has continued the same, consisting of rice, and salt and vegetables. Fish and milk, of which they occasionally partook, have become expensive luxuries on account of their increased price, and the wear and tear, to which they were now liable more than before on account of greater labour called for to produce a larger quantity of rice both for home and foreign consumption, must have induced a failing stamina of health. A weak fortress gives way at the first assault, and a weak constitution succumbs under the presence of a poison against which a stronger one maintains its ground for some time with success.

But taking for granted the actual poverty of the people, can it be said that pauperism knows no distinction with reference to any portion of society at large? Do the Zemindars feed less than before,

and do the civil European Officers with their princely incomes come under the same category? Yet scarcely *one* instance can be cited of persons living in and breathing the tainted atmosphere who has been completely free from its influence. All my inquiries on the subject have enabled me to establish one point, namely, that the working classes have suffered most and amongst them the greatest mortality has taken place. Out of them again those remain still serviceable for work who command better incomes. I am afraid to give my countenance to a belief which is likely to prove injurious to society, but I must confess that the general opinion is, that those that have recourse to some sort of narcotics as wine, tobacco, or gunjah, have fared better than those who do not. Poverty does not bring about the disease primarily, for the villages in Bengal are on a par with reference to the condition of their inhabitants; and yet why should the Burdwan district receive the preference to others claiming similar disadvantages? But when once the disease is introduced into the system, poverty plays a very important part in retarding convalescence, bringing on repeated relapses after fatigue and exertion, and hurrying on those *sequelæ*, from the complication of which the patient finds it impossible to extricate himself. Thus the greatest mortality has been

amongst the poor working classes, whilst the rich have escaped with comparatively little suffering, but no party have enjoyed absolute immunity.

The *second* theory advanced to explain the immediate spread of the Epidemic, is the super-addition of the element of contagion to the original disease, that helps it to spread from village to village through the agency of human intercourse. The asserted facts on which this view is grounded can be briefly summarized. First, that the fever has spread along the railway line. Second, in places beyond the railway, the villages more severely "affected lie on the line of the Grand Trunk Road." Third, the simultaneous appearance of disease amongst the members of the same family. And Fourth, the spread of disease from one village to that adjacent.

Some facts bearing on the question and brought to light by one of the Inspecting Staff a year subsequent to the actual outbreak of disease, gave the theory a shade of importance. He found out, in his inquiry, that one village in the district of Burdwan succumbed to disease after a few patients from the epidemic-stricken locality had taken their refuge in it with actual fever in their persons.

Those, who have anything to do with any local inquiry, will attest to the difficulty, nay sometimes the impossibility, of getting at truth from the

ignorant villagers when dates are concerned, and especially when they extend beyond a year. In several local researches I made about the outbreak of cholera, I found out that unless the history was traced within a few days of its occurrence it was past record and observation. The first appearance of cholera always makes a greater noise and creates a greater sensation than fever, which, on account of its very commonness, will pass unobserved and unnoticed. When therefore with regard to cholera the difficulty to trace its first appearance is so great, *à fortiori*, it amounts to impracticability with regard to other less attractive diseases, especially when the investigation is made a *year* subsequent to their occurrence. The facts brought forward by contagionists are either not wholly true or may be accounted for in a different way altogether. First, the fever has *not* taken the course of the railway line, but has spread from Mugra north, south, and west, without observing any definite route. Second, the mortality has been heaviest in large towns and populous villages, which generally stand on the Grand Trunk Road. Third, the simultaneous appearance of the disease amongst members of the same family previously enjoying freedom from it, is owing to general perversion of the air. Thus, amongst my own household I was first attacked in July. After one week,

my eldest girl, who used to sleep in an adjoining room, was next affected, then my wife, and subsequently the servants. In a fortnight every person went through his turn of illness. But it is to be remembered that the appearance of the disease is rather sudden. The very week, in which myself and my family were the sufferers, brought on universal disturbance of health over the length and breadth of the district. The communicability of a disease cannot be satisfactorily traced when the Epidemic is at its height and when the prevalence of the disease is universal. But during its decline it is not uncommon to meet with sporadic cases of the worst type in individuals who have never imparted the disease to their immediate attendants. I can cite at least one hundred instances under my personal observation, and I seldom observed more than one case of fever amongst the members of the same house from April to July. After July the fever becomes generally wide-spread, and any conclusion arrived at during its height must be accepted with caution and reserve. The contagious nature of the fever being thus discarded, its fanciful resemblance to typhus or relapsing fever will at once come to the ground. The difference will be more manifest when we come to treat of the symptoms and progress.

The theory which, in my opinion, satisfactorily accounts for this explosive outburst of disease, is the one by which all visitations of epidemic diseases are generally explained, viz., the assumption of the *existence of some climatic change* which feeds as it were the active principle of disease and favours its multiplication. The causes I have before enumerated are each and all sufficient to stamp the country with an endemic malarious fever. No one will deny the fact that the three months after the subsidence of the rains throughout India, especially in Bengal, have received the unenviable notoriety of being called *the fever-months*. The fever, prevalent about this time, though not so general and wide-spread as the present one, is of sufficient virulence to count numbers of victims. Following the close of the rainy season, and fixing for its particular habitat the alluvial soil of Bengal, rich with organic vegetable matter, the fever has been naturally associated with these conditions in the relation of effect to cause. Whatever the term *malaria* may signify, we understand by it *that invisible agent which is generated from moisture and vegetable decomposition.* Nor does the idea seem to be based on mere hypothetical ground, inasmuch as their combination and sequences are so constant that, given the two factors, the non-production of

the disease will form a medical curiosity. In Burdwan this fever has borne such constant relation, in its appearance and intensity, to the time of setting in of the rains and the quantity of rainfall, that one would not go far beyond the mark if he were to prognosticate on these data the severity of the fever with which the country might be visited. Thus, whilst in the preceding years fever commenced early in consequence of the early setting in of the rainy season, in the year 1873 the rains having been late, the appearance of the disease was correspondingly late. In fact it was not till August that it showed itself in the district.

It is in the intensity and gravity of their *results* that the *epidemic* disease differs from the *endemic*. But the former presents some peculiarities which can hardly be explained by the simple endemic theory. Its main feature is, as we have shown already, that it is travelling, slowly indeed, but, as some have remarked, yet travelling. Excluding from our consideration the outbreak in Jessore in 1824, we have found it in our own time to have travelled in thirteen years from Nuddea to Hughly, from Hughly to Burdwan, and from Burdwan to Midnapore and Bancoorah in an uninterrupted course. Unlike the sweeping but uncertain marches of cholera and small-pox, its progress has

been slow and sure, unmarked by fluctuations indemnifying from its ravages particular tracts of country, but all the contiguous villages within the range of its fell influence have been one after another absorbed in the general vortex of disaster. The insidious way in which one village after another was attacked, decimated, and restored to its former condition without any apparent change in the habits of the people or the aspect of the country, points to something more than fixed local causes. An epidemic disease shows itself without any assignable cause, soon reaches its climax and as inexplicably dies out. An endemic disease is generally traceable to some neglect of sanitary regulation, steals its march on society by slow degrees, intensifies by length of years, and unless the defective condition is remedied, clenches itself on the land with an obstinacy which obtains for it the permanent notoriety of unhealthiness. During the prevalence of fever in Burdwan the people became more and more pauperised, sanitary conditions were neglected and the villages wore a deserted appearance. Under such unfavourable conditions an endemic disease was more likely to be intensified than mitigated with the advance of years. We have observed that difference of soil, difference of drainage, and difference of water-supply furnish no explanation of its present intensity. The

drainage of the town of Burdwan I have examined to be as perfect as it can be wished, only there is one railway feeder that intercepts to some extent the water-course of the neighbourhood. And yet as regards sufferings and mortality it was the worst locality in the district. Places on high laterite soil in Beerbhoom have not been exempt, whilst villages that are regularly swamped by inundation of the Damudah, have suffered to a very small extent. The following general facts may be mentioned as the result of my investigation in the villages under my own immediate inspection.

1*st.* The large populous villages have suffered most.

2*nd.* Those bordering the river side are worse off than those farther inland and more elevated.

3*rd.* Places with better sanitary arrangements recover before others.

I have not seen perfect restoration to health in any village in the Jehanabad circle, but the standard of health varies according to difference in the sanitary condition.

I have stated my belief that the disease, rendered endemic from the various ordinary and extra-ordinary causes in operation, has now taken an *Epidemic* character by a peculiar climatic influence. I will now proceed to explain its *modus operandi* consistent with the facts previously noticed.

Small-pox or cholera is known to prove more virulent and more liable to spread one year than another. This excessive mortality cannot be accounted for in any other way than by the supposition of the existence of some toxic agent in the air which feeds, as it were, the *contagium* of disease, and makes it more potent. The active principle of every disease requires a soil or nidus for its growth, without which it will wither or die out. Small-pox, introduced into a deserted island, must cease to spread. It requires the soil of the human organism for its growth and development. In the same way it will die out in a society if there is no susceptible individual to receive it in his system, as it has been stamped out of countries where by the law of the State every individual is protected by vaccination. Given this favourable soil, cases of small-pox will be generated *ad infinitum*. Dengue, when once let loose amongst a community where it was previously unknown, manifested its influence in a wide-spread epidemic, which disappeared as the susceptibility of the individuals wore out and the soil was exhausted.

Malaria differs from these animal poisons in the mode of its generation and multiplication, being independent of human agency. It owns the earth for its habitat. A deserted place, or a jungle, is as deadly to visitors as, sometimes more than, an inhabited locality. It may multiply itself *ad infinitum*

from the soil till it is so much intensified as to taint the very air. There are records of armies having got disabled by simply marching through malarious swamps. Thus we have two classes of poisons to deal with, one owning a human soil for its generation and multiplication, the other the earth. The activity of the earth-soil is far inferior to the activity and changes going on in the human system. The greater the activity the more rapid is the reproduction of the poison, and the more rapid the reproduction the more rapid is its spread beyond the affected area. Hence the multiplication of malaria being slow, the extension of it is correspondingly slow. Unlike the rapid strides of cholera and small-pox, the influence of malaria is confined within the village where it is generated, and when it does spread, it is limited to places in its immediate vicinity. In a favourable season, the poison of cholera and small-pox will take root, breed, and multiply when wafted across from one place to another if it can find materials to feed upon. But malaria under similar circumstances will just be able to communicate itself to the place adjoining it. As long as there is any susceptible soil in its immediate neighbourhood for communication, so long would an epidemic of malaria progress onwards, till its march would be effectually stopped by coming in contact with land where it can no longer find materials to breed and multiply. It is

thus that a river course has been often found to retard or stop its advance, and at places its boundary line has been abruptly defined. It is communicable therefore in the sense that it can infect a contiguous locality, but all clinical observations negative the idea of it being communicable from man to man. I have before observed that every disease requires a favourable soil to be *endemic* in a country, but it is the addition of a poison in the air that gives it an increased potency and thus converts it into an *epidemic* agency. We have in the soil dead and decaying vegetable matter, excessive rainfall, bad and insufficient drainage, rice cultivation, retentive nature of clay, silting up of canals and rivers. By the long-continued action of accumulating filth, the disease was generated, and the epidemic spark was supplied to blow up the whole into a flame. Thus in a series of years, devastation spreads from one village to another, and it is thus the disease travelled from Nuddea to Midnapore. This rationale accounts satisfactorily for the causation and spread of the disease. I have gone through the several items of food, habits and clothing of the people, as well as the nature of the soil and drainage of the villages, and arrived at such contradictory results that I verily believe that they are of secondary importance, capable of aggravating but not of primarily inducing this epidemic perverted state of health.

2.—Malaria.

In the preceding pages, I have had often occasion to refer to this Burdwan *Epidemic* fever as being identical with *Endemic malarious* fever, only more intense and more generally diffused. I have refrained from making any observation on the nature of malaria, which, from the time of Hippocrates until now, has remained an enigma. Even during the last year there has been an extensive controversy kept up in the *British Medical Journal* by talented medical officers, such as Surgeon-General Maclean, C.B., professor at Netley, and others, who have had ample experience of it, in both tropical and temperate climates. In fact the poisonous element, the *materies morbi*, of most specific diseases has hitherto baffled all our analytical research. For instance, we know that the lymph contained in the variolous pustules or the fang of a serpent contains some unexplained poisonous agency, which introduced into the blood of man, will breed, multiply, and develop its kind, whether bacteria, germs, or microscopic germinal cells, such as those developed immediately in the blood by the poison of venomous snake-bites, as demonstrated by Dr. Halford. (Vide *Australian Medical Journal*, 1870.) In typhoid fever the poison is excreted through the alimentary canal, and in cholera the morbific

matter, it is said, is carried away with stools and vomited matter. In syphilis the gummatose nodule contains the poisonous element, and yet the nature of each and all of these poisons is enveloped in such mystery that we are not in a position to elucidate by physical, chemical, or microscopical characters, the peculiarities of these agents. Yet the very fact justifies an *à priori* conclusion of the existence of such a poison in the fluid when its contact with human blood invariably perverts or vitiates its constituents. Similarly we have not been able to detect the active principle of malaria, but we consider our position strong enough by analogy, when judging from effect to cause we presume it to be some heterogeneous element present in certain conditions of air, the exposure to which generally gives rise to perverted state of health. The word *malaria*, therefore, is of empiric origin, and has its foundation on the experience of past observers. However writers may differ in accepting the nomenclature, they agree in the main in their belief that it is an accompaniment or emanation of moist condition of soil, whether in a tropical climate, or in the temperate localities of the Pontine marshes, or those of Holland, Lincolnshire, or Essex. Whether the action of the one upon the other results in the production of this new material, or that the so-called malaria is nothing more than ordinary

"chill" caught in a moist tropical atmosphere, has lately been the subject at issue. One at least of the parties in the controversy just alluded to, holds that chill is the real thing, and that malaria is a myth. Other views have been advanced by different writers with reference to its causation, as existence of spores in the air of certain *algæ* resembling the Palmellæ, by Dr. Salisbury; and by Rasori, half a century ago, as the *materies morbi* of marsh miasma; or a low organism developed from putrefaction of vegetable substances, as by Dr. Nilmeyar.

Though, like all other specific organic poisons, malaria has not been detected nor its nature as an entity proved, yet, I believe, the assumption explains a wider range of phenomena than any of the other hypotheses can pretend to solve.

I have already alluded to views of malaria as ascribable to heat, moisture, and vegetable decomposition. Simple warmth and dampness of air will not give rise to malaria.

We will now proceed to substantiate our argument by examining the different climatic conditions under which malarious fever prevails.

The hottest months in Bengal are April, May, and June, when the thermometer in the shade stands from 95° to 100°. The nights are pleasanter, and often a south-easterly wind serves

to keep down the excessive heat at night. Now and then the bursting of a storm with showers of rain, attended with loud thunder, effectually cools the atmosphere for days. But the powerful sun soon dries up the moisture of the soil and lights up afresh the ethereal fire. The ground is dry and hard as stone, and is cracked and fissured. The sky is clear of clouds, and at night the cessation of radiation of heat from the earth's surface chills the air and makes the contrast pleasant and agreeable. The people sleep out of doors to avoid closeness of atmosphere, or sleep with their doors and windows open. Towards morning there is just sufficient fall of dew to moisten the vegetation. The mean difference in the range of temperature between day and night is about 23°, and on cloudy and rainy days it is still greater. Rice cultivation, the staple crop of the land, remains in abeyance, and the shallow khals, tanks, and streams become dry or fordable.

This period is succeeded by the rainy months of July and August, with constant downpours of rain. The sky is cloudy and overcast, the grounds are sloshy, and the fields retain no less than a foot of water for raising the paddy. The tanks are full to the brim, and every lowland is under water. The fordable streams swell to navigable rivers, and carry a strong current of water. The drainage

of the country being defective, there is at every step a collection of water in pits, holes, and cesspools. The sun is no longer so powerful in the day, it being below 90°, but a feeling of oppression is experienced on account of saturation of the air with moisture. The invisible evaporation from the surface of the body becomes deposited in the shape of perspiration, which soaks the body and brings out a troublesome crop of prickly heat. The nights are still, and the variation of temperature ranges between 12° to 15° between day and night.

In the autumnal months of September, October, and November, the sky clears up again, the rains cease, and the sun resumes its heat. Though the mercury seldom goes above 90° as in summer, yet the heat of the day is felt peculiarly pungent. The nights are cooler, and the fall of dew is heavy. Just after sunset the earth ceases to radiate heat by reflection (according to Wells's theory), and a thick cloudy, foggy dew settles upon the face of villages and towns. Very few venture to expose themselves to night air, and the people resort inside the rooms for sleep. The water from the villages begins to drain away, though it still remains in the paddy-fields for maturation of the crop. The tanks, streams, and khals begin to subside, exposing a lately submerged soil to the action of strong solar heat. The atmosphere

continues loaded with moisture, but not to saturation as in rains. The thermometrical variation between day and night continues from 12° to 15°.

In December and January the actual cold weather is experienced. The sky is clear, and the atmosphere gets drier as the season advances. As the harvest is reaped in January the rice-fields remain only partly submerged till the end of that month, after which they rapidly dry up. The temperature in the day varies from 70° to 80° and at night is as low as 50°. The range of variation increases as in summer, and yet with all, the climate is felt to be bracing. It is prejudicial, however, to the health of the poorer classes, who are insufficiently clothed, and are therefore ill constituted to bear the change. In them, the convalescence is delayed by frequent relapses, but the recovery of the upper classes dates from the period when the actual cold season sets in.

Now, taking into consideration the period from April to March, we have the following figures showing the number of admissions from fever and its *sequelæ* in the dispensaries under my inspection in the years 1873 and 1874.

	April	May	June	July	August	Sept.
1873.	22,688	21,157	20,501	18,606	17,665	17,976
1874.	20,213	17,900	17,018	16,773	16,295	17,071

	October	Nov.	Dec.	January	February	March
1873.	23,760	25,882	25,962	24,613	21,991	20,939
1874.	23,127			29,392	27,598	29,463

From them it will be seen that the increase of illness of the poor begins to take place in the month of October, when the variation of temperature is at its minimum, reaches its height in November and December and then slowly subsides till June. It is exactly the period that coincides with partial subsidence of water from the face of the earth, which is exposed likewise to the heat of a powerful sun, and this period of unhealthiness continues till June, when the ground is dried to cracks and fissures. If we are to account it as due to "chill," it will remain to be shown why it is not so active in summer months, when from the extreme heat of the day to pleasant variations at night, the major part of the people expose themselves to its cause by sleeping out of doors, and without sufficient protection. Nor can it be sufficiently explained, why, in rainy seasons, with the atmosphere loaded to saturation* with moisture, the malaria is not at its height. Does the experience of marine surgeons corroborate the prevalence of

* It is maintained by Dr. Oldham that moisture is a great heat-abstracting agent, and is a fruitful cause of chill.

any malarial disease out in the open sea, when, in the summer months, we have almost all the conditions of malaria combined, viz., heat, variation of temperature, and moisture at night? Here we have the factor *soil* removed from our consideration, and if it can be proved that at sea, as on land, malaria fever may prevail epidemic amongst the crew, there cannot remain any more doubt as to its causation. It has been averred that the variation of temperature must be accompanied with a certain amount of cold and moisture. Does the humid climate of England in winter, with variations of as much as 20° in twenty-four hours, furnish cases of malaria fever in that season? All the asserted causes put together, shall we not feel tempted to seek for malaria in its worst form in colder regions than in the tropics? On the other hand, is it not a fact that in India better health is enjoyed with the actual setting in of cold? If we find damp soil essential to its production, and if simple moisture in the air without the soil, as in an open sea, is shown to be impotent to give rise to it, I do not know how we can avoid the conclusion, that there is something in the soil itself apart from moisture, that has to be credited for playing an important part in its generation. It has been objected to on the ground that granitic, sandy, and other soils have been found to be

malarious; but the discrepancy gives way before the fact that some disintegrating granites and sands have so much incrustations of organic matter that virtually they are not far removed in their composition from the richly charged alluvial soil. Another inconsistency is pointed out; that supposing malaria to be the noxious agent developed from the soil by the active effect of heat, why is its intensity not more at daytime, when its evolution is greatest, than it is at night? It is a truism established by experience, that people do not undergo the same risk of catching fever by passing through a malarious locality at daytime as at night, although in the former instance they are not altogether free from such liabilities. The rationale of it is simple enough. In that season of the year, when its evolution is most active, the rapid chill after sunset condenses the air and moisture in the stratum immediately in contact with the earth, and its effect is communicated to the atmosphere up to a certain height from the ground. The dense foggy air envelops the face of the earth as a cloak, and can be plainly demonstrated in the air of towns and villages after dusk, where, instead of diffusing, it hangs upon the soil like smoke, and marks in an abrupt outline the upper clear stratum from the lower. Malaria, being an outgrowth of the soil, mixes also and

is diffused with the vehicle air, but at night, instead of being carried away widely by the current, settles itself with the vapour on the spot, and grows in its intensity by evolution and concentration. In the daytime the rarefied air disperses the toxic agency and dilutes it, long before the dose of concentration is reached. Hence there is less risk at daytime by exposure, though one cannot reckon upon an absolute immunity from its invasion.

Thus on the assumption of malaria being a real entity, the phenomena of fever in a damp locality are easily accounted for. But I believe it will be saying more than we are warranted at present in declaring, that the same phenomena do not occur under any other circumstances. There are various other agencies that act on the human system in the same way as malaria, by producing an effect on the vaso-motor system of nerves, and "chill" is pre-eminently one that simulates it in its result. Thus it is that observers have been misled to attribute to it the sole cause of fever by observing some isolated cases under their care. Any shock on the sympathetic, as a surgical operation or the passing of a catheter, is known to be followed by febrile symptoms, and it will be as much correct to say that malaria is synonymous with shock, as to assert it to be identical with "chill." The chill

theory, therefore, explains no doubt a certain number of cases, but the adoption of it as a whole is scarcely warrantable. As for the spores and vegetable organisms, we have only to add, that their specific identity or special abundance in the air of malarious climate, more than they exist in common at other places, remains yet to be proved, and experiments undertaken to confirm their presence have given but negative results.

3.—Symptoms.

I have already observed that the fever prevailing in Burdwan does not differ materially from what used to ravage the district towards the end of the rainy season. It is of malarious origin, and varies in type according to the severity of the poison and the constitution of the recipient. The characteristic feature of malarious diseases is their periodicity and tendency to recurrence. The longer intervals of health indicate a system less influenced by malaria, whilst a stronger dose of the same will induce in the same individual less and less of intermission, till the fever will merge into the remittent or continued type. Thus one would pass through the phases of quartan, tertian, quotidian, double quotidian, remittent or continued, and the danger to life will increase

as the climax is reached. All the varieties are changeable from one to the other, and do not in themselves form distinct species. Thus in the first year of the epidemic, cases of the continued and remittent types are observed, which are mentioned by the native Kavirajs as *Jwar bikár*. As the severity declines it becomes quotidian and ultimately quartan. The last type of fever prevails extensively in the district of Burdwan, and shows that the poison is wearing itself out. The new cases are observed in August and September, when the subsidence of water from the face of the earth gives fresh impetus to the generation of malaria.

The mode of attack of the villages one after another is very peculiar. In the first year, the villages adjacent to an epidemic-stricken locality will show at the close of the rains more of ordinary fever cases and greater mortality than usual. But this, being virtually nothing more than what they are accustomed to in some fever season, will not create any alarm or grave apprehension. With the approach of winter, the fever disappears and the people congratulate themselves on the change. The old cases recover and continue their ordinary avocations. The second rainy season brings with it a recurrence of the disease, which this time becomes more general.

Nearly every member of every household is affected, and the village is panic-stricken. Deaths from acute fever run high, and those that survive are marked for constant recurrence of the same. With the prolonged suffering, complications begin to appear, such as enlarged spleen, liver, anasarca, &c. Late in winter a respite is obtained which continues till a third rainy season brings on with it fresh suffering. The mortality this year is heavier, not from acute disease, but amongst chronic patients who succumb under slight depressing causes. The suffering being general, there is seldom any person spared in a family to attend to the sick. Instead of improving in summer, the fever continues, as well as the mortality which takes place from dysentery, anasarca, and cancrum oris. In the fourth year, death from acute fever becomes still less, but the chronic cases swell the list of mortality. Slight abatement in its severity is again observed in summer, when the fever, formerly quotidian, takes on a quartan type. In the fifth year the virulence is much spent. Though the people suffer, they are yet able to attend to their duties and earn their livelihood. Fever with them becomes a natural phenomenon. Unless it be a very strong attack, it never deters them from eating, drinking, and bathing as usual. In this

condition some recover their flesh enough to show an apparently healthy appearance. Medication is no longer resorted to, and to all intents and purposes, there is restoration of health, peace, and tranquillity. A great many yet suffer from quartan fever, but as I have already said, their system gets so accustomed to the suffering that they do not attach much importance to this state. In the majority a permanently enlarged indurated spleen is left, but it becomes a part and parcel of the necessary constituents of their body. Most of them would remain without fever for months or years and yet their spleens remain undiminished in size. The slightest cause, however, upsets their balance of health, and every now and then cases occur, which are hurled on from bad to worse and ultimately terminate fatally. When this state of things continues, which is more marked in the sixth year, we pronounce a village as restored or recovered. I have not yet seen a village perfectly regain its former salubrity, though some of those that were less affected and less populous and possessed better sanitary arrangements, have approached a condition very near to it. Some villages bordering the line of the epidemic went only through two stages of illness and have now rallied.

Whilst the village affected goes through its

stages of desolation, other new ones are absorbed in the vortex of disaster. The encroachment is slow, and goes on extending one year after another till in twelve years' time the epidemic has travelled, before our very eyes, from east to south-west, an extent of territory no less than 70 to 80 miles. I have not met with any village in my jurisdiction which has been completely exempted from its ravages. But there are certainly some tracts of country to be found here and there, where the visitation has been less disastrous. Their topographical condition and the habits of their inhabitants will form another chapter of our discourse. The extension has taken place more towards west than south, and more towards south than north, whilst be it remarked that the drainage level of the district runs from north-west to south-east.

This slow but sure travelling of the disease and its invasion of one village after another, have given rise to the suggestion of the epidemic being not of malarious origin, but consisting of some such element that bears the stamp of contagion. Dr. Verchere in Burdwan and Dr. Greene in Serampore sounded the alarm note respectively of the fevers being typhus and typhoid in nature. These epidemics, they assert, leave the system so enfeebled that it becomes an easy prey to

malaria which is endemic to the soil, and from the constant recurrence of which the people suffer off and on. A great many other writers incline to the view of communicability, though they do not differentiate the types.

Dr. Elliot inclines to the belief that the fever in Burdwan possessed decided power of communicability, and the Deputy Inspector-General Dr. Sutherland subscribes to the same opinion. According to him, it appears "that a fever of a highly infectious character may originate and spread from intensified malarious influences, aided probably by bad ventilation and the emanations from the bodies of the sick. That the fever, described by Dr. Elliot, did assume an infectious character, I do not doubt, and that the excessive mortality in certain localities depended on this is, I think, rendered highly probable; but it is only in certain favourable conditions that such a result would occur, and if the ordinary endemic fever of the place exists at the same time, the fact of there being an intercurrent wave of infectious fever may be easily overlooked. In the long period that has elapsed since the first appearance of epidemic fever in Jessore in 1824 up to the present date, it is very probable that fevers of very different characters prevailed." That the disease broke out in all its virulence as contagious, and in

two years changed its peculiar characteristics, cannot be easily credited, since what is now observed in the newly affected area, is nothing more than the continuation of the first outbreak in Burdwan. The apparent show of contagiousness which has misled some observers, arose probably from the fact of the simultaneous appearance of disease amongst the members of the same family. The simultaneous appearance of disease amongst members of the same family or of different ones proves nothing more than general perversion of the air. At the very height of an epidemic, when the cause is powerfully operative, every one is subject to it alike, and of course those are more liable who undergo bodily and mental strain by waiting on their sick relations. Under such circumstances, it is expected that case after case would take place in the same house without any contagion to account for it. If it had been limited to the members of one house whilst the others enjoyed absolute freedom, as occurs in an outbreak of cholera, the theory of contagion would have been undeniable. But in the present epidemic the suffering is acknowledged to have been universal and no family was spared, the priority of attack being determined by the predisposition which exhaustion and fatigue would lead to.

It has been observed that towards the end of

winter and just when the hot summer sets in, a few fresh cases of remittent fever come under treatment. These take place mostly in boys under fifteen years of age and take a dangerous turn. They are very obstinate in their course and run on for ten or fifteen days continuously, bringing on great prostration and emaciation. They are essentially in their type analogous to the virulent fever observed at the commencement of the rains, only they are confined to a few individuals and have no tendency to spread. These are the cases that I have mentioned previously as sporadic, and from which I have deduced my conviction of the non-contagious character of the fever. Their per centage of mortality is great, though they generally mark for their victims those that had shaken off their previous illness and had apparently recovered. The cause of this sudden manifestation has not been satisfactorily made out. This fever has been described by many as heat-fever, appearing with the change of season, and attributable to the direct effect of solar heat on the human system. The explanation seems to me not to afford sufficient solution of the fact of the preponderating number of boys suffering as compared with adults who from the very nature of their occupation are more exposed to this cause than the former. Some look upon it as typho-malarial fever generated from

the decomposition of manures and accumulated filth in the villages under the influence of a powerful summer sun. One fact, however, should be mentioned as a coincident circumstance, that from the middle of February to the middle of March, the first ploughing of the land is commenced. After the last harvest is reaped, the water from the fields subsides and the ground is dried up. It becomes in a manner settled, charged as it is with remnants of manure and stumps of rice stalks. May not the first turning up of the soil liberate a fresh dose of malaria, which, however, is not of sufficient strength to prostrate adults who possess greater powers of resistance, yet potent enough for the constitution of boys, especially those who had shaken off its influence? I offer this simply as a suggestion as to how far the two circumstances can be associated in the relation of cause and effect, though I confess sufficient evidence is yet wanting to admit them as proved facts.

The first attack always proves to be of the continued or remittent type, and is looked upon as dangerous. After the prodromata of general languor, lassitude, costiveness, wandering pains, want of appetite, the fever is ushered in by a chill followed by the hot stage of several hours' duration; generally there is complete intermission in

the first day, but next morning the attack recurs. The symptoms are now more exaggerated, the face becomes flushed, the thirst is intense, the tongue is thinly furred, and there is headache attended with bilious vomiting and sometimes delirium. The patient feels an intense pain in the limbs as if bruised all over. The hot stage may or may not be followed by sweating, but there is no more that feeling of ease after the lapse of a few hours. The fever remits and he continues to feel thirsty, drowsy and heavy in the head. The temperature reaches its maximum and ranges between 100° to 104°, with a fluctuation of 2° to 3° between the morning and the evening indications. This state continues for three or four days when the prostration becomes greater, the tongue is more thickly coated, and delirium supervenes, which takes place more often at night and is of a quiet nature. The bowels remain costive, and active purgation is very badly tolerated. On the fifth or sixth day copious sweating brings the case to a termination. If the strength be not properly supported throughout the illness, the diaphoresis may end in collapse. The skin gets cooled down to 96° or 97°, and if advantage be not taken of this period of quietude to anticipate the coming storm with good doses of quinine, we may expect in the evening a recurrence of the symptoms, and the

fever tending to become intermittent, instead of continued, in character. Thus, along with the decline or severity of the disease, we have the different phases of intermittent, remittent, or continued fevers in one and the same individual, the different types being well marked both during the period of invasion and subsidence. The merging of one type of fever into another distinctly observed at its commencement and end, distinguishes it from typhus, which runs its equable course and ends in complete and sudden defervescence. Thus an ordinary case takes seven or eight days before convalescence is established, but when once under the influence of malarious fever, the slightest cause, as exposure, fatigue, or irregularity of diet, will bring on what is ordinarily called a "relapse." This relapse, unlike the relapses of true relapsing fever, does not observe any regularity as to time. It is quotidian, tertian, quartan, weekly, fortnightly, or monthly, according to the capacity of the individual to withstand its effects.

Exceptional instances occur, which are too puzzling for diagnosis, in which instead of the convalescence being established in eight or nine days, the attack lasts longer and ultimately takes on a *typhoid* type (low, like typhus, the original meaning of the word). These are generally the results of neglect in seeking for early treatment, or of

some peculiar idiosyncrasy in the individual. The cases continue from two to three weeks, during which a high temperature is kept up with occasional variation, the tongue, at first thickly coated and moist, gets dry on the surface, and ultimately brown sordes collect on the teeth and lips, and even petechial eruptions make their appearance. As a rule, the bowels remain costive, and it is exceptional to find looseness of bowels as a complication. When it does exist, the cases are more obstinate and take longer time to recover. These are generally called "bilious fever" from the frequent presence of bile in the stool. The copious discharge of green fluid from the intestinal canal and bilious vomiting have a tendency to end critically in collapse. Drastic, hydrogogue cathartics are to be carefully avoided, as too often I have traced the sudden turn of disease from bad to worse to a dose of jalap or salt. Whilst on the one hand listlessness, drowsiness, prostration, delirium, dryness of tongue, and sordes make the case resemble an attack of typhus; on the other hand analogy is equally strong with "typhoid" when, along with the existence of the preceding symptoms, we have a prolonged duration of illness, spots, and diarrhœa. It is no wonder that practitioners, on an imperfect

observation of a few cases, should jump at a conclusion, which is so tantalising, and startle the world with a discovery hitherto unrecognised by the profession. The differential symptoms of both will be treated of under the heading of Diagnosis. As a rule the spleen and the liver both become enlarged and tender. Death takes place in the second week of illness from exhaustion, or it may not take place till the third or fourth week, when it is generally due to complications of the lungs. When it takes place in the first week, it is due to cerebral complication, or to a concentrated dose of the poison acting on an enfeebled constitution and bringing on sudden collapse during the sweating stage.

Death from cerebral complication is more common in villages newly affected, where after a suffering of four to five days' duration, it is not uncommon to find people struck down as it were with convulsions, coma, and death. In the majority of instances, symptoms of headache heaviness in the head, drowsiness and delirium precede, but in others the attack is sudden. It takes place in the remittent and continued types, and even in the intermittent type during the height of the paroxysm. In children, it is a common and formidable complication, as one or

two such fits end in death. In adults, life may be prolonged to two, three, or more days in this state of unconsciousness, but recovery is seldom observed. The patient remains on his back with the limbs stretched, rigid or flexed, pupils slightly contracted, pulse over 100 and temperature varying from 100° to 103°. Insensibility from brain complications, and that from exhaustion, can be distinguished by the following characters. The first occurs early in the course of the disease, the second later on. In the former, the insensibility is deep, the patient lies motionless, and the limbs are rigid. The temperature is invariably over 100°. In the latter, there is a good deal of restlessness, patients can be roused by loud calls, and temperature is below 100°. Between the insensibility of typhus and that of malarious fever there is this distinction: That the latter is immediately preceded by head symptoms, whilst in typhus, the headache, as a rule, disappears, and then coma supervenes (Murchison). Whilst in typhus death begins at the heart, in malaria it begins at the brain. The early feature in typhus is failure of the heart's action, and prostration; the early feature in malaria is failure of nervous functions and delirium.

The second mode of death is by exhaustion. To call a fever sthenic or asthenic is as much

objectionable as to call ulcerative action healthy or unhealthy. *Fever is always debilitating in its nature, more or less.* It is specially so in constitutions previously underfed and kept starving at a time when the vitality is being consumed away by increased pyrexia. This is exactly the condition with most of the poor people in Burdwan, whose time-honoured prejudices will not allow them to have recourse to nourishment as long as the active stage of fever lasts; except one or two sugar bubbles and a mouthful of water to wash them down, the patient is kept literally starving with the view of consuming away the vitiated humours. Want of nourishment brings on more prostration, and want of sufficient fluid in the system causes retention of effete nitrogenous products. These combined may manifest themselves in *typhoid* symptoms, which have often been mistaken for typhus fever. The rapidity with which these patients recover under simple nourishment is sometimes marvellous, and I have often had the satisfaction of restoring to life, if I may be allowed the expression, patients who were apparently too far gone into the typhoid state, by enforced administration of nourishment. Death from exhaustion seldom takes place within the first week of illness, unless, as I have previously remarked, an officious prac-

titioner brings it about by the administration of an active purge after the fifth or sixth day.

4.—Diagnosis.

Acute malarious fevers closely resemble in their symptoms typhus, typhoid, and relapsing fevers, but they have certain main features by which alone they can be distinguished. Without going the length of denying altogether the existence of typhus and typhoid in India, well-marked cases of which have lately come under observation, I give an emphatic denial to the statement that the present epidemic has the characteristics of the one or the other. From typhus it is distinguished by the absence of contagiousness, by the eruption and by peculiarity of temperature. Dr. Murchison states that typhus is contagious in 92 per cent. The unmistakable instances of contagion he enumerates bear no parallel in the history of the present epidemic. The cases from which the advocates of the typhus theory draw their conclusion, were treated in the police hospital of Burdwan, which consists of a hall no bigger than 40 × 30 feet, into which more than twenty beds were crammed —indeed, the beds touched each other. The worst case was placed in the centre bed of this

hall, surrounded by cases of fever of various degrees of intensity, mostly intermittent. The ventilation of the room was defective, owing to the shutting in of the doors, windows, and arches with mats on three sides to keep away the draught. Yet the disease was not communicated to a single patient or attendant. The seizure of the several members of the same family at a time when the fever was raging all over the district, gives a fallacious indication of contagiousness. The eruption in typhus, according to the same authority, passes through three stages: first, pale, dirty-pink, or florid; second, reddish-brown or rusty; third, livid and petechial. In the first it is slightly elevated and disappears on pressure. In the second it disappears in part and is no longer elevated. In the third it is not affected by pressure. Generally it appears on the fourth day and lasts from seven to ten days. In uncomplicated cases, as a rule, it continues till death or recovery. He lays some importance to the fact that simple petechiæ do not constitute typhus, as they are observed in the course of many other diseases both febrile and non-febrile, but a *rubeoloid eruption which often becomes converted into petechiæ on the eighth or ninth day.* These are observed in 93·2 per cent. The spots seen in the course of malarious

fever appear on the side of the chest or arm on or about the middle of the second week. They are present in some exceptional instances, and not until grave typhoid symptoms have supervened. It may be stated at a rough estimate that they are absent in 93 per cent. of instances. They are distinct and defined, about the size of a pin's head, and petechial, unpreceded by the stage of rubeoloid effervescence. It may be argued that in dark complexions the primary stage is not well marked. I have often watched the surface of the body for rash of any sort whatever in open daylight, but have never been able to discover either mottling or elevation, though, when we had an outbreak of measles along with it in the district, the eruptions, even in dark skin, were unmistakable. The peculiarities of temperature in malarious and in typhus fevers will at once clench the diagnosis. In typhus it attains its maximum from the fourth to the seventh day, and it is 105°. There is little change for several days afterwards. A slight remission is observed between the seventh and the tenth days, but on or about the fourteenth day it *rapidly* subsides to its normal standard. After the final fall, it seldom rises above 100°. In malaria, there is complete intermission on the first day. On

the second or third day it reaches its maximum, and continues with slight variation between the morning and evening indications for four or five days (in bad cases for a longer period without any definite rule), till it begins *gradually* to decline. From continued or remittent it takes on an intermittent character, and goes on for days unless checked by a sharp dose of quinine. The rise and fall for some days after defervescence show the peculiar termination of malarious remittent into intermittent—a termination which, if it had been typhus, would weaken the theory of specific diseases. The sequelæ from which the majority suffer will further disabuse the mind of the typhus element which was asserted to have been the initiator of the epidemic.

From typhoid fever the diagnosis is easy enough. The peculiarity of temperature in malaria, when contrasted with that of typhoid, will give a valuable clue to diagnosis. Thus, if on the second or third day, the temperature rises so high as 102° or 103° we can at once make up our mind that the case we have to deal with is not enteric fever. Besides, looseness of bowels, a constant element in the latter, is an exceptional attendant on malarious fever. It is a complication only of the bilious remittents, in which, however, its early appearance

as a bilious flux, and the bilious vomiting and hepatic tenderness, mark the distinguishing features. Remittent fevers complicated with dysentery have often been mistaken for typhoid, and more than once, cases were reported to me as such by native doctors when personal inquiry revealed the true nature of the disease. In these instances, the history of the patient should be carefully sifted. In a case of acute hæmorrhagic dysentery it will require all the tact of the practitioner to differentiate the character. The gripe, the tenesmus, the constant desire to go to stool, and the nature of the stool itself, together with the history of the fever having been simultaneous with the so-called bloody evacuation, will settle the doubtful point. Cases of malaria do now and then occur in which the profuse bloody discharge from the bowels simulates what takes place in the insidious forms of typhoid, but the previous cachectic constitution in the former, the enlarged spleen, scrofulous gums and discharge of blood from other mucous passages, are conditions wanting in the latter disease. Add to these the morbid condition of Peyer's patches in typhoid or enteric fever, and we complete the list of symptoms that would serve as diagnostic between malarious and typhoid fevers.

The analogy between malarious and relapsing fever is so distant and far that only a very power-

ful imagination could convert this distant analogy into an identity. I have already expressed my belief that the Burdwan fever is not contagious. Nor do the relapses observe any regularity as to the time of their appearance. The similarity consists merely in the fever being continuous for a few days and then recurring for an indefinite number of times with the least exciting cause. The diagnosis which was arrived at by Dr. Lyons from a distance of seventy miles without having a single case under his direct observation, does not deserve to be entertained or discussed upon.

We now proceed to describe some of the complications which are the accompaniments of the fever, and from one or other of which the majority of people in the district of Burdwan are suffering. These are what are called the

5.—SEQUELÆ.

The first and most frequent in order is enlargement of the *spleen.* It is found in at least three-fourths of the people affected, and varies considerably in size, from being just perceptible under the costal cartilages, to filling up the whole abdomen. In a female it occupied such an immense bulk that a Sub-Assistant Surgeon mistook it for an enlarged ovarian cyst and suggested operation as the only

means of cure. The fixture of the tumor above and its comparative mobility at the lower end convinced him of the error in his diagnosis. In children, indurated, enlarged spleen is very common, and it is this which makes the belly so protuberant. From a distance the pot-bellied feature with distended veins on the surface of the abdomen gives an appearance of dropsy, but palpation will soon decide the question. Abscess of the spleen is a rare termination. A case was shown to me at Jehanabad as such, but on examination I satisfied myself that it was an abscess over the spleen between the layers of the abdominal muscles, opposite which the tail of the organ had contracted adhesion with the peritoneal wall. The absence of any serious symptom helped me much in arriving at the conclusion. In those in whom the organ becomes enlarged to a good size at each febrile accession and diminishes as rapidly after its subsidence, the enlargement is a fluid one from accumulation of blood, but in others it is formed of organized tissue and the feel is tough and indurated. The greater the induration the longer the time it takes in recovering. The indurated organ after the lapse of time becomes a natural constituent of the body and is compatible with health. Such is the case with the people in those districts where the influence of malaria after a

prolonged continuation has worn out. The enlargement is attributed to a sub-acute inflammation, but in no time of the progress of the fever is any complaint made indicative of an inflammatory action going on. Sometimes an aching pain is felt over it, but never before the organ has assumed a good bulk. The enlargement is made up of tissue that forms the trabeculæ and the investing sheath of the spleen. I consider the thickening as not an inflammatory process, but allied to natural hypertrophy due to constant fulness of the organ from stasis of blood during each paroxysm, when, as a diverticulum, the blood tends to collect in it. The softening of the spleen is rare, and my experience is borne out fully by the observations of other officers in this endemic district. In the absence of an opportunity for post-mortem examination, I cannot definitely say whether any death from that cause has resulted. In cases of inflammatory deposit the subsequent change of contraction is of frequent occurrence, causing atrophy of the organ. In the liver, as I will presently notice, such changes take place very often. But in the spleen my experience fails to cite one case where atrophy followed enlargement. This would have been the result, at least in some instances, if the process were altogether inflammatory. Congestion of the spleen takes place in

all remittent fevers when the organ becomes enlarged and tender.

Enlargement of the liver is not so common, and is observed in about twenty per cent. of patients seen. Its enlargement is generally due to subacute inflammation of the organ. In size I have never seen it extend below the umbilicus, and it is always associated with enlarged spleen. As in all inflammatory process, pain and tenderness over the organ are felt. The inflammation ends in some instances in suppuration, giving rise to large circumscribed abscesses. Intemperate habit has nothing to do with this morbid change, as I have seen as many cases in boys as in adults whose habit was abstemious. In one out of six cases, a previous history of dysentery could be traced. The abscess points externally, with all the characteristic symptoms which it is not our object to describe in detail. Suffice it to say, that in three cases it burst through the lungs. In two of them a favourable result was obtained, and the other died from its effects.

Any thickening or enlargement of the margins of the portal fissure through which the vena porta enters the substance of the organ, will lead to obstruction to the portal circulation and end in ascites. The large prominent veins on the surface of the abdomen show the obstruction offered to the

venous blood, which obstruction is relieved by the effusion of serum into the peritoneal cavity. The proper secreting structure of the organ not being affected, jaundice is rarely seen.

Dropsy is the sequela with which these cases take a fatal turn. It is dependent on two different causes: 1st, hepatic; and 2nd, general. Hepatic dropsy is the result of enlargement or cirrhosis, and is seldom recovered from. The lean emaciated limbs and haggard countenance set on a bloated trunk give a most unsightly appearance. Nutrition is interfered with from the inability of the individual to take in sufficient quantity of food, and emaciation progresses till death takes place either from the pressure of the fluid inducing imperfect aeration of the blood and bronchitis, or from dysentery. In most of these cases the history is, that they had suffered previously from fever with enlargement of spleen and liver, which, however, left them to enjoy a good interval of health. The collection of fluid in the abdomen was gradual and not attended with very acute symptoms. In some a previous history of dysentery can be traced, but besides these the patients suffer at the time from no other symptoms beyond what is felt by the mechanical distension of the fluid. It is noteworthy that when habitual drunkards become the

subject of malarious fever they are more liable to this turn of the disease.

General dropsy is the result of an impoverished condition of the blood. The anæmic appearance, bloated face, œdematous limbs, laxity of tissues, all point to mal-nutrition. Diarrhœa or dysentery sometimes attend these symptoms, and the patient is much reduced in strength. Irritative fever helps to lower him still more, and unless timely treated with tonics and nourishment, cancrum oris makes its appearance and puts an end to his miserable existence. It is remarkable how these patients improve when placed on a liberal and easily digestible diet, as milk and rice. The equilibrium of secretion and absorption is restored, the tissues regain their natural firmness, and the œdema and peritoneal fluid are removed if the kidneys are gently acted upon. The majority of these cases are recoverable unless too far advanced. Unlike the other variety, the splenic enlargement is a common complication.

Cancrum oris mostly occurs in boys under the age of fifteen. It generally takes place towards the end of summer or beginning of rainy season, when after prolonged continued suffering the vitality is reduced to its lowest ebb. In the height of the fever-season other sequelæ are more common than this. It seems quite unaccountable why the

reduction of vital strength should be indicated by sloughing of a part, which, in the healthy state of the system, is freely supplied with blood and the injuries to which are quickly recovered from. It is always accompanied with dysentery, and prevails at that season when ulcers of gum and aphtha are most common. Associated with disorder of the bowels, and having for its primary seat the mucous structure of the cheek, it is a question whether the lesion is to be looked upon as a reflex phenomenon symptomatic of irritation in the intestines, or as a primary enervation of the soft structures which at once take on an erysipelatous inflammation and end in rapid sphacelus. By whichever way it is induced, the putrefaction of secretion goes on most actively, initiated probably by the agency of bacteria which abound in the salivary secretion of the mouth. The fœtor of the breath is most sickening, and has the chance of producing death by putrid infection by keeping the patient constantly in a halo of vitiated atmosphere. The extent of sloughing varies from a patch of the size of a quarter rupee to extensive sphacelus involving the whole cheek and inducing necrosis of the superior maxilla. Horrible destruction of tissue takes place, producing ghastly features. The orifice of the mouth is supplanted by a wide gap, on the floor of which the tongue moves about

with a peculiar wriggling motion. Extensive lesions are seldom recovered from, but a moderate degree of sloughing would heal with thickening and contraction of the surrounding tissues. Atresia oris and difficulty in opening the mouth make the future existence of the patient miserable to the end. No other condition will induce it with greater certainty than when, in a broken down constitution, an acute attack of fever supervenes with dysentery. The subjects are always anæmic and possess large indurated spleens. Allied to the ulceration of the cheek, is the peculiar scorbutic condition of the gums and their ulceration. The loose teeth, swollen gums, and their tendency to bleed are marked more in one season than in another. The ulceration is superficial and may expose the roots of the teeth by destroying their soft covering, when they drop off. From the cheek the ulceration may extend to the hard palate and produce necrosis and perforation. It should be borne in mind that in persons of undoubted scorbutic gums, extraction of a tooth has been attended with fatal consequences. The constant oozing of blood from the socket proves too obstinate to be checked by any astringent application, and the patient dies in twenty-four or forty-eight hours from the effect of slow hæmorrhage.

Dysentery is sometimes an attendant complica-

tion of malarious fever. It is most frequent in the months of December and January, when increased cold, greater ranges of variation in hygrometry and temperature render the badly clothed peasants more liable to such attacks. It can be divided into two varieties according to their cause; the first is due to change of season, and the second to bad and insufficient nutrition.

The first variety occurs in persons who may or may not be the regular subjects of fever. They present tolerable health and, as a rule, are free from splenic enlargement. The enlarged spleen acts as a safety-valve in all internal congestions with which each attack of fever is attended. If from toughness of the organ its distensibility is interfered with, the determination takes place to the intestines and produces dysentery.* This is the only explanation

* It is due to Dr. Sircar to mention here that this is what he long ago insisted upon. In a series of articles published in the *Indian Field* (now defunct) in review of the "Report of the Committee appointed to inquire into the causes of the Epidemic, its course, and the best means of checking its further progress," which were afterwards published in a pamphlet form in 1864, gave expression to the following ideas upon the subject:—"The spleen, in fact, appears to us to act as a safety-valve to the disturbed functions of the alimentary mucous membrane and of the liver. We have accordingly always looked upon the early enlargement of the spleen as a salutary sign. And we have almost invariably seen that in these fevers the gastric and the hepatic derangements continue obstinate, so long as there is no perceptible enlargement of the spleen. The first effects, therefore, of the enlargement of the spleen, are to avert the tendency to diarrhœa and dysentery. Again, the assumption, by these fevers, of the remittent type, seems to us to depend upon the want of an adequate safety-valve action of the spleen. And it is a notorious fact, that it is in the inter-

I can offer to the frequency of dysentery in malarious localities and which coincides with the fact of its existence mostly in persons whose spleens are not enlarged. Otherwise I deny the existence of any such disease as malarious dysentery, which writers, like Dr. Maclean, maintain. The per centage of dysentery cases amongst hospital attendants seldom rises over five even in the worst season of the year. Such a small number will be found also in places that are not malarious, and their presence should be looked upon rather in the light of coincidence than as an usual accompaniment of malaria. In the month of January the eating of new rice is a fruitful cause of bowel complication, which may terminate in dysentery. It is a fact that a sharp attack of dysentery will in some instances reduce the size of spleen.

The second variety is observed in emaciated weakly individuals suffering from enlarged spleen and liver and whose constitution is broken down from continued suffering. This form of dysentery is most obstinate and is allied to famine-dysentery. Malaria has nothing more to do with its causation than, by inducing broken health, it helps to predispose the system to it, when the blood itself is vitiated for want of proper and sufficient nourish-

mittent variety of the disease, that this organ is found the earliest and the most frequently enlarged."

ment. Being due to a putrid condition of the blood these cases are difficult of treatment, and often prove fatal. Dysentery might occur with contracted liver as the premonitory stage of ascites.

Pigmentation of the skin was found in four instances only. The complexion of the skin assumed a dark bronzed hue, as in Addison's disease. Two of these cases were under my own personal observation. Both of them were free from spleen, and fever in them took place very seldom. In one the change of colour set in just after recovery from an attack of dysentery. The mucous membrane of the mouth was blackened in patches in both instances. Half an ounce of blood was taken from the arm of one of these patients. It yielded 2 grs. of fibrine, on being stirred with a rod. Microscopical examination was unavoidably delayed for a week, when it was seen the blood corpuscles were fewer in number and wanting the dark central spot. Probably it was due to imbibition of fluid and decomposition that was induced in the serum by long keeping.

The change in the blood from malaria can be briefly noted in the following words: a hydræmic or a watery condition, deficiency of red and increase of white corpuscles, and deficiency of fibrine.

From this hydræmic state of the blood much danger is to be apprehended in those conditions

of the system which bring on sudden excess of its watery constituents, as hæmorrhage, or those which add to the plasticity of fibrine, as fever. The liability of pregnant women to embolism of the heart, especially in a malarious district, has never before been pointed out by any observer. Four such cases have come under my personal observation, in two of which it came on after parturition, and in two the symptoms were manifest during an acute attack of fever supervening in the eighth month of pregnancy. The hæmorrhage in the two former instances, and fever in the two latter, determined the formation of clot in the heart.

Besides, the watery state of the blood engenders an hæmorrhagic diathesis. Bleeding from the nose or gums is a very common complication. It takes place mostly in children with indurated spleen and sallow complexion. Death from slow persistent hæmorrhage after extraction of a tooth has been reported by previous writers. I had occasion to notice it in only one instance, when the bleeding was stopped with some difficulty after twenty-four hours' slow oozing.

Bleeding may take place from the mouth or rectum (melæna). The profuseness of discharge in such instances is often a subject for grave apprehension. In females an acute attack of fever

sometimes brings on untimely the menstrual flux. I have seen four instances of melæna, three of which proved fatal.

Allusion has already been made to the anasarcous condition of the limbs which is the result of water in excess in the blood. Alteration in the quality of the blood renders it unfit for healthy nutrition. Its effect on the nervous system is shown in general languor and mental inaptitude. I have seen several cases of epilepsy both in boys and adults who have had the disease since they became regularly subject to fever, but whether it is to be looked upon as a coincidence or a sequence I am not in a position to decide. Most of the cases entered in the dispensary returns as rheumatism are nothing more than perverted nervous feeling in the limbs. These cases abound in places where malaria is fresh and not deep-rooted. Hemeralo pia or night-blindness is as much indicative of deficient nutrition of the system as of alteration or cessation of nervous function of the retinal structures.

Some writers attribute impotency to malaria, but the numerous instances of child-birth in the district negative any such assumption. General debility no doubt represses the procreative tendency, and under this head are to be credited the cases of abortion and still births which are not of infrequent

occurrence, and which tend materially to keep down the number of the population.

6.—Treatment.

The treatment varies according to the stage of the disease. It requires thorough discretion and competent judgment to enable the patient to tide over the first attack, but when once it is got over and merges into a chronic type, any combination of quinine as tonic will be all that will be necessary in the shape of treatment. The reputation which some of the quack medicines have attained in the cure of fever is owing to their containing quinine in fair proportion. In Jamalpore a Pundit made his fortune by selling a mixture of his own composition, and so much as 100 bottles per day were sold in the fever season. D. N. Gupto's mixture received a very encouraging support, but this trade in mixtures fell off when quinine came to be freely supplied from the Endemic Dispensaries, and when the people became sensible enough to learn that the recovery was a mere temporary one. The attendance at and reputation of a dispensary in the endemic district depend more upon the quantity of quinine given than upon the skill and attention of its medical officers. Thus the daily attendance

in one dispensary rose from thirty to four hundred directly quinine was supplied for distribution, although no extra attention was paid in the discrimination of the proper nature of the disease. From six to nine grs. of quinine were given indiscriminately, and every patient bore testimony to the marvellous efficacy of the mixture supplied. Wherever arsenic or carbolic acid or any other antiperiodic was substituted, the people lost faith in the medicine and the dispensary suffered in consequence. Thus it shows that quinine is *par excellence* the best tonic and antiperiodic. In it we have a powerful remedy to check the progress of intermittent fever, and whatever has been said against it to detract its virtue, is not in conformity with the general experience. Even the patients themselves would ask to be supplied with quinine as the best remedy which their experience dictates. But the frequent relapses after recovery, even whilst the patient is under the quinine treatment, shows that it has no curative or protective property.* To give quinine as a preventive of malaria is, I consider, a mistaken idea, for it is only powerful in remedying that condition of the system which is induced in

* Dr. Richardson has lately pointed out that quinine acts by preventing evolution of oxygen in the blood, to which he believes the phenomena of febrile paroxysms are due.

every attack of fever by its peculiar effect on the ganglionic system of nerves, and thus restoring temporarily the equilibrium of health. A good dose before an expected paroxysm of fever acts more powerfully as a tonic and counteracts the depressing effect of malaria which is shown in the disturbance to the cutaneous circulation. The paralysis of the vessels and their dilatation form the principal phenomena of the stage of pyrexia. Quinine acts in remedying this condition not only in malaria but in other diseases, such as insolation, in which experiments have confirmed its power of reducing preternatural heat of skin. In all cases of intermittent fever I content myself in giving a single large dose of it three or four hours before the expected paroxysm, and prefer it to small doses which, when given at repeated intervals long before the accession of fever, are excreted by the kidneys and do not exert much beneficial influence. After the fever has left, half a grain of it, with mineral acids and iron, may be administered for some days as a tonic, but should not be continued uninterruptedly for any length of time with a view to ward off any future attack. It should be repeated again and again when the threatening symptoms of fever begin to show themselves. If more than this is expected from this drug, disappointment will be the result.

The other medicines that have been recommended as antiperiodic, are arsenic, carbolic acid, strychnia, atees, &c.

Arsenic has been in vogue amongst the native Kavirajas as febrifuge from a very ancient date. They use it in acute as well as in chronic fevers complicated with anasarca and when, as they say, the phlegmatic humour preponderates in the system. White arsenic and sulphuret of arsenic are the preparations used; but according to them if arsenic could be burnt to ashes without volatilisation (?) it would be the panacea for all diseases. Liqr. arsenicalis does not prove as effective as white arsenic, and is everywhere unfavourably spoken of. The number of patients fall off from the dispensaries if arsenic is largely prescribed. Its action being slow, several days' administration is necessary to produce a perceptible effect. In others it brings on irritation and increases the severity of the fever. It is contraindicated in remittent congestive cases—or those in which the liver and spleen or any other internal organs are congested, or those complicated with dysentery or diarrhœa, or in those that are extremely emaciated from chronic suffering and have an irritable disposition. The most favourable cases are the quartan types of fever occurring in able-bodied men without any

internal complication, whose system has been saturated with quinine without any benefit. Carbolic acid answered in very few instances. In several cases it increased the febrile symptoms and delayed recovery. It succeeded in very mild cases of the quotidian type in which it is difficult to say how far the good was attributable to the medicine or to the *vis medicatrix naturæ*. In irritable and sanguine temperaments it disagrees. Its nauseous odour is a great drawback to its use. Its power of checking fever is very inferior to that of arsenic.

Strychnia or some preparations of it are very useful in persons whose systems have been saturated with quinine and in whom further administration of quinine acts as an irritant.* Other antiperiodics are atees, neem, &c., but their effect is too slow and uncertain.

In the remittent type of fever, great care is necessary in its management. A purgative at the outset should be given and debilitating remedies should be withheld. If the bowels be relaxed a dose of Gregory's powder will free the bowels of irritating matters and relieve the tendency to congestion of the internal organs. Quinine in the acute stage acts injuriously, especially when

* Dr. Aitkin's triple syrup of phosphate of quinine, iron, and strychnine, forms the safest and mildest combination.

given in large doses. Even when given during the stage of remission, it seldom succeeds in putting a stop to the exacerbation. I never give more than ten grains, if the case be a favourable one for its use; but the following prescription given every three hours for days, with support of the system by nourishing diet, generally brings on remission or intermission.

℞

Dec. cinchonæ ʒi
Liqr. amm. acet. ʒii
Acid. nitric. dil. ♏x
Spt. ether. nitrosi ♏xx. Mix.
Every three hours.

In cases of debility nitric acid is replaced by carbonate of ammonia, which acts both as stimulant and diaphoretic. Bearing in mind that fever is always debilitating in its nature, the strength should be carefully supported throughout the course of illness by proper nourishment, as milk and broth. Active purgation after the first week should be withheld. I even allow the bowels to remain loaded for a day or two unless there be very urgent need for interference. Hot sponging should now and then be practised to allow the skin to act freely. I have no experience of aconite or veratrum, and cannot say how far they are useful in bringing down the abnormal heat of skin, but I have often

used tinct. cannabis or digitalis with good effect with the above mixture. When long-continued quotidian fever merges into remittent, active medication should not be practised unless there be urgent need for it. When the head is affected, cold water is an invaluable application. Other symptoms should be treated as they appear. The treatment of pneumonia should be always stimulating, with mild counter-irritants to the chest.

When intermission or full remission is obtained quinine can then be administered in five-grain doses. In chronic cases quinine with iron and mineral acids is very beneficial as tonic. Although it seldom helps to bring on complete recovery it has been found that those who use that medicine constantly have suffered less in health, and the sequelæ of fever in them are insignificant in proportion. Attention should be paid to the state of the bowels, and any tendency to diarrhœa should be checked by opiates. Inasmuch as cancrum oris is always indicative of a low state of vitality, good wholesome diet should be secured, with tonics, stimulants and wine. Iron, carbonate of ammonia and chlorate of potash should be given with caution, for fear of their inducing irritability of the bowels.

Ascites due to a watery condition of the blood is very amenable to treatment. Quinine, iron and

diuretics with milk-diet would soon bring on convalescence. It seems to be the revival of the old practice amongst the Hindus of keeping all anasarcous patients with looseness of bowels chiefly and solely under milk-diet treatment. The good nourishment gives tone to the tissues, and insufficiency of water in the blood makes it seek for that fluid amongst structures where it is redundant. Ascites due to liver disease is most difficult of treatment. The fluid must be let out through the way of the secreting and excreting organs, the kidneys and the bowels, by means of elaterium, saline purgatives and diuretics, as nitric acid, tartrate of potash. Salines should not be given freely in the other form of ascites, where it will deteriorate the condition of the blood and retard convalescence and recovery. Purgatives are to be administered with discrimination, as there is a great tendency to dysentery from which most of these cases prove fatal. I have never seen a case recover after paracentesis, and I have to speak of it only in condemnation as a method of treatment that hastens death. Iodide of potassium with digitalis and nitric ether will form a good diuretic combination.

The best treatment to effect reduction of the size of the spleen is to ward off as much as possible each attack of fever or shorten its duration. A

counter-irritant over the splenic region helps to make the organ soft and gradually smaller. Ung. hydrarg. biniodid. is the best counter-irritant in these cases. It should not be applied, however, in weak emaciated patients, or in those suffering from constant febrile heat, or in little children, or in ascitic cases, as the irritation of the blister makes the case worse. The skin ulcerates and is apt to take on an unhealthy action.

The spleen simply enlarged and unaccompanied by fever sometimes becomes a natural organ of the body and cannot be reduced. Preparations of iodine, as Syrupus ferri iodiæ, may help much to cause its diminution in size. Chloride of ammonium was once much spoken of, but it has not satisfied the expectation of practitioners who have given it a trial on the recommendation of continental physicians.

The native way of treating an enlarged spleen is by applying the actual cautery over it. This practice is very extensively resorted to, so that in a malarious village one scarcely walks out but meets with persons with scars over the abdomen. From one to as many as thirty of them have been applied at a time, and cases have been brought to my notice where persons have died in consequence of irritation, sloughing, and exhaustion from the discharge from the cauterised surfaces or from hæmorrhage.

Various native methods are followed, of which the following is mostly in vogue in the district of Jehanabad.

The surface of the abdomen corresponding to the tail of the spleen is daubed with oil to the size of one rupee and a dried palm-leaf is applied over this, covering the oiled mark. The burning end of a stick of pith is then rubbed over and over till the leaf is charred. The operator constantly blows on it to prevent it from setting fire to the leaf. The charring heats it to a degree to produce a singeing effect on the corresponding portion of the skin beneath. The patients give expression to their suffering in loud cries and restlessness. The whole operation is over in a minute's time.

All these treatments are ineffective or partially successful as long as the patients remain in the tainted locality. Early removal from such to a better or more salubrious place offers the only chance of restoration to health.

7.—Preventive Measures.

In proceeding to treat of the preventive measures, one might well breathe a desponding sigh at the hopelessness of the task. It is said that to know the disease is half the cure, and when we have fixed definitely on some causes out of the

numerous factors that bear some share in the origin of the disaster, it might appear that the amelioration of the evil is not much beyond our power, but the cost it would entail to set the likely remedy to action seems at first an overwhelming obstacle in the way. Virtually, the physical aspect of the country will have to be changed and the habits and mode of living of the people will have to be altered, for as long as the Hindu remains a Hindu with his peculiar filthy habits, always acting in opposition to all sanitary laws, so long would the permanent improvement of the health of the people remain a mere phantom. There has been a backwardness in undertaking the necessary operations on the score of the uncertainty that may await the result, but it may be safely declared that capital, sunk in the land for its general improvement, is sure to be productive of benefit in the end.

Before describing the methods of prevention we will compare the actual condition of those villages within the affected area where the visitation of the epidemic has been milder and less fatal, and try to deduce therefrom our plan of action. I have before mentioned that complete indemnity from illness has been nowhere observed within the area of my inspection. But the places I am going to narrate fared so well in comparison with the others that it will not be far from the truth to mention them as

having escaped the ravages of the epidemic. Three of them, Sankta, Dhamnaree, and Soobulda, lie on the western side of the Damudah, in that tract of the country in Thauah Roynah which is annually inundated by the overflow of the river during the rains. They stretch along the western side of the Bachoordah khal. Since the northern bank of the Damudah has been secured by embankment to give protection to the railway line, the southern has been opened out at Hijulnah, Bago, and Sreekristpore to give exit to the periodical overflow. This part of the country therefore has been recently subjected to flooding. The body of water rushing in through the breach at several places above mentioned spreads over fields and villages, and washing an extent of land no less than three miles in breadth, flows due south to discharge itself again into the river farther down in its course. The bulk of this water subsides within forty-eight or seventy-two hours. The amount of sand thrown up has rendered the ground unproductive, except at places where silts of an alluvial nature have enriched the land with manure and rendered it fit for a profitable cultivation of melons, pumpkins, and tobacco. This is undertaken immediately after December and is over in May. Rice-fields have deteriorated and its cultivation nearly abandoned. It is pitiable to see what an immense tract of land has thus been rendered

fallow and has been overgrown with long grasses and reeds. From July to September most part of it is under water to the depth of 2 to 3 ft., so that the people ply across in canoes and rafts. The Bachoordah khals, which consist of several distinct channels in communication with each other, carry strong currents of water and are deep enough to allow boats of 100 mds'. capacity to pass with impunity. Remaining under water for the whole of the rainy season the tract of country has received the name of jullah or marsh. After September the water begins to subside from the face of the fields, but the deeper channels of the khal continue full though fordable. Most of them dry up in December and the whole then presents a dry sandy soil, where the grasses grow luxuriantly. The delay in the subsidence of water is attributed by the villagers with some truth to the gradual filling up of the bed of the khal towards its mouth opposite Jotseram, where indeed scarcely a channel is left, but the force of the inundation makes for itself each year a fresh passage. The inundated fields have risen in their level by each year's increment and the encroachment of the water has become wider spread. Yet with all this they dry up sooner than the neighbouring rice-fields, which remain wet till February. Lying within this circle of inundation are several scattered villages, where

the inhabitants have been struggling against nature to maintain a precarious footing. For the protection of property and person, they have year after year raised the level of their villages and of the basement of their houses by addition and deposition of earth. Thus in the villages of Dhamnaree and Soobulda the floors of huts are no less than 10 or 12 ft. high from the level of the surrounding fields. The construction of huts is by no means peculiar, excepting that the majority of them are isolated. They are peopled by the farmer class and their condition is anything but thriving, owing to the deterioration of the productive powers of their land, notwithstanding which they have to pay to their Zemindars unmitigated rent of the year. Their mode of living is not different from their brethren of other villages, except that during the period of flood they have to live, as they say, from hand to mouth.

Whilst the inundation has brought upon them these distresses, it has improved the appearance of their villages by its general effect of scouring. It cannot be denied that these villages look neater and more tidy. Everywhere vegetation and filth are washed away, and the filling up of the tanks annually replenishes their water and clears them of aquatic weeds. In some of these places I tasted of the best water that I have ever drunk. Thus the *overflow of the river acts indirectly* in promoting the

sanitary condition of the villages through which its water flows. I have premised that the villages bordering on this line are, as a rule, healthier and have presented less mortality than those in their immediate neighbourhood. But amongst them, again, various shades of gradation are observed. Thus Goonore, a village removed only a mile from Sankta, presented an opposite state of health. It scarcely differed in any material way in the local advantages it enjoyed, excepting that it was larger and more populated, and situated more on the bed of the khal than on its side.

There are other villages in this neighbourhood, situated between this khal and the river Damudah, which are older, larger and more populous, such as Sreekistopore, Jotseram, Rajarampore, Shadepore, &c., but the amount of sickness and mortality in them exceeded much in proportion. Most of them are also under water in the flood season, but the *water rises in them by a process of slow filling up* and as slowly subsides. The result is therefore totally different. *The water of the tank is simply undrinkable* and full of aquatic vegetation. The soil is most jungly, and shrubs and under-woods abound. A more uncleanly state of villages cannot be imagined.

Besides, the drainage of these villages is obstructed. The body of inundation water passing

in at Hijulnah is met by another of greater force and velocity that finds its way in at Bago. The striking of the two at right angles to each other neutralises the current and causes stagnation higher up the stream. The fulness of the stream in its turn prevents other minor khals from draining themselves into it freely, and thus surcharges the villages with moisture of which they are the drainage media. The cultivation of pumpkins, melons, &c., I have previously referred to, is undertaken only at this portion, where the stagnation of water favours deposition of silts. The resulting force of opposition deflects the course of water more towards the west, when it resumes its natural direction a mile or two below the spot. Where the current is strong the bed is deepened year after year, and thus the height of the villages contrasted with the level of the fields becomes more marked.

In the Mangulcote circle Dr. B. Gupta has come across a tract bordering the Adjye where similar conditions are obtained. The overflow of the river, the drainage of the surplus water by a kahl running parallel to it, and the immunity of villages on its inland side, are too significant facts to be overlooked.

From the foregoing facts the following conclusions may be drawn.

1st. The main distinctive condition of villages

that have been less threatened with malaria and death is their newness and scanty population.

2nd. All of them are seated on an elevated soil, either natural, or made artificially so to subserve a special object. The greater the difference between the elevation and the general surrounding level the more stiking is the improvement.

3rd. They are more tidy in their appearance, present less jungles, enjoy better sanitary conditions, and their soil dries up sooner after rains on account of greater intermixture of sands in its ingredients.

Having the foregoing facts in view, we should attempt to improve the sanitary condition of villages as well as of their surroundings. Any improvement in the dwelling of the people will indicate improvement in their social condition, which in their present state of society is well nigh impracticable. Jungles should be cut down and growth of bamboo in thick clusters prohibited. Small honey-combed pits should be filled up and the existing large tanks cleared and deepened. Those that are used for drinking purposes should be surrounded with high mounds to prevent them from being defiled with ground washings. Surface drains should be cut in every locality with a good outfall, leading into a deep one on the farthest boundary of the village towards which the drainage inclines. These drains or khals, joined with similar

others in the neighbourhood, should have their ultimate fall into a navigable stream. Wherever a new road is constructed, it should be amply provided with culverts, and the earth should be dug along one side of it in the form of one continuous canal. The dead should be buried or burnt out of the limits of human habitations.

Outside the villages the fields should be looked after. A country prosperous with rice cultivation cannot be healthy. If water be allowed to collect in every patch of ground, it will necessarily impregnate the soil with dampness. But rice is the staple article of food and there is no alternative in the production of the crop. A thorough system of irrigation with in and out-flow of water should be introduced, which will render it unnecessary for the peasant to attempt to keep rain water in the fields. Rice cultivation within the heart of a village should be prohibited.

Any existing obstruction to drainage by bunding a canal, either for fishery or agricultural purposes, should be put a stop to on penalty of a fine, and the existing bund opposite Selimabad should be opened out to restore the flow of water into the Kana Nudee. The mouths of small khals are to be kept open, otherwise once obstructed they will fill up gradually and turn the flow of water into a different channel.

Deep khals should be cut in jullahs to convey the stagnant water, and some sort of cultivation introduced.

The habits of the people must be altered. A better standard of living is an indispensable necessity. Better clothing and better food will enable them to bear against malaria or any vicissitude of temperature with greater power of resistance than before. The habit of defæcating on the pond side should be discontinued; grounds should be allotted outside the village for such purposes, and the dry earth system of conservancy adopted. The refuse in time should be carted away to the neighbouring fields to supply manure to the soil. The custom of early marriage giving rise to a generation of imbecile paupers, whom their parents are not able to sustain, should be discouraged as much as possible.

If all these measures could be followed out, my conviction is strong on the point that we shall reduce the chance of disease and mortality to a minimum. Yet some degree of unhealthiness will remain in operation which is the result of causes beyond human control. Thus, the nature of the soil will remain unaltered, which is sure to be acted upon in the rainy season with the immense quantity of rainfall which is natural in the tropics.

APPENDIX.

ON THE PAST AND PRESENT STATE OF MEDICINE IN INDIA.

AT a time when deep and impenetrable gloom pervaded the face of Britain, and her sons divided the sovereignty of the land with ferocious denizens of the forest, India was then in the zenith of her civilisation. From a date far beyond human records, the Eastern nations have enjoyed the celebrity of being a civilised race, confessing a systematic government of their own; their own social and political laws and science, that, even in this period of enlightenment, draws forth admiration for its subtilty and ratiocinations. Under the auspices of its own independent chiefs, the country grew to distinction for refined thoughts and science, and formed itself as a centre from which radiated the light which has enlightened different ages. The science of astronomy had reached its acme, political and social laws well displayed the in-

genuity of the race, whilst medicine had been systematized to an extent which was creditable to the era in which it was instituted. But the star of prosperity was not long destined to shine over the country, for a cloud was gathering far northward fanned by the Mohammedan breath, that was to enshroud the land in the profoundest gloom. With the usurpation of her independence, a deadly stroke was dealt at the root of all advancement, and thus the bud of learning that was about to fructify was blasted in its very germ. For centuries India groaned under the iron sway of Mohammedan potentates, and Mohammedan zeal and fanaticism served to extinguish the last flickering of learning that died away with her last independent chieftain. With the characteristic intolerance of the Moslems, Mohammedan religion and literature were enforced by the sword, and an attempt was made to demolish anything that savoured of ancient Hindu relics. Thus with the deprivation of India's independence ended her literary career, and, whilst every moment was threatening to absorb the fallen nation to oblivion, it was reserved for the glorious British power to bring them again into existence.

Thus it will be observed that the Hindu science and literature are of a far off ancient date, the advancement of which was suddenly put a stop

to by changes in the ruling power of the country, and having had no further opportunity of polishing and improvement, they have run down to posterity in a crude state, and stand, therefore, in strong contrast with the refined thoughts of the present generation. No wonder, then, that the idea of the world of a Hindu should be restricted to the notion of a triangle, having been imbibed in those ages when the science of navigation was yet in the womb of futurity. India, at that remote antiquity, bounded, as it was, on the north by the range of mountain that has yet defied the patient researches of an Everest, was considered to be the farthest limit of the then known world formed by those high rocky barriers whose snow-topped summits lost themselves in a distant horizon. Impenetrable for their height, and presenting a still more unkindly climate, the Hindu mythology fixed them for the abodes of their idolatrous gods; and, when you associate with those hills, the source of that mighty river that washes the length and breadth of the land, conferring on its course those immense advantages, both as regards vegetation and facility of human intercourse, which ancient Hindus even in those ages were too subtle not to take cognizance of, you can conceive why the Himalayan chain should be extolled with adorable sanctity. In an age that foreshadowed

the history of all other nations, you find an attempt to put every branch of science into a method and classification. Nor was the cultivation of medicine thrown in the back-ground whilst her sister sciences were undergoing their share of scrutinous research.

In introducing the subject I cannot help referring to the fact that, in India (especially in Bengal), people were divided into various castes, of which three principal forms were recognised, the Brahmin, the Voysho, and the Sudra. These three held their relative ranks in society, in the numerical order they have been mentioned, and had peculiar privileges and occupations of their own. Thus, the high-caste Brahmins consisted of the order of priesthood, and were considered the only persons eligible to sacred and religious rites. Their occupation was the culture of Sanscrit literature, astronomy, and the learning of the Vedas; and for such noble undertakings, which they professed, their person was looked upon with veneration by the unhallowed Sudras. The Voyshos were the traders and merchants, and formed the aristocratic portion of the population as far as wealth was concerned. Their sons were not considered as eligible to the learning of Sanscrit; and thus the crafty priesthood succeeded in monopolizing for themselves the literary portion

of the world. The low-caste Sudras formed the working class, which supplied the society with servants, labourers, and husbandmen. Out of the first two there soon arose a sub-class, by the name of Voydos, or the *physicians*, who conjoined in them the intelligence of the Brahmins and the wealth of the Voyshos, and they formed the caste of the *last reigning monarch* with whom was extinguished the Hindu dynasty of Bengal. They were the class of people who were peculiarly privileged to practise medicine and to prepare and administer drugs. In those ancient days, medicine and surgery formed separate branches for practice; for, whilst the former was held in so high an estimation, the latter, limited as were the means and instruments in those times of ignorance, was professed by the barbers of the village, whose practice extended to nothing higher than the opening of abscesses and extraction of thorns. Nor is the fact to be wondered at when we learn that even so late as the 19th century the learned body of the Royal College of Surgeons of England owed their origin to the class of barber surgeons.

The science of medicine in very ancient times among the Hindus was divided into three sections—Anatomy, Materia Medica, and Medicine. With the existing prejudices, it was not compatible

to expect anything like dissections and sound basis of anatomy. Dead bodies were looked upon with horror and aversion, and handling and hacking them for knowledge were against their religious principles. A nation that considers the person of every one as polluted who even touches the corpse of a relative, and prescribes ablution of the body in the holy river in the way of expiation from corruption, cannot be expected to make much progress in anatomical research. Yet, impressed with the necessity of such knowledge, they had deduced it apparently from dissection of goats. Their knowledge of the human skeleton was obtained by keeping a dead body submerged in water for some time; so when decomposition set in, the soft parts separated, leaving intact a skeleton of bones, united by ligaments or bonds of union. With such drawbacks in prosecuting the fundamental principles of medicine, their views were equally erroneous. Thus, the navel was looked upon as the centre part of the blood vessels, from which radiated branches for the upper and lower extremities. The blood was supposed to remain in admixture with certain humours, as bile and phlegm, or wind; and the preponderance of one or the other in the vital fluid was considered to form the keystone of all diseases. Nay, they presumed to understand by the hardness and quick-

ness of the pulse which of the humours was in excess in the system. Thus vague as was their knowledge of circulation of blood, I think it is not far from truth to interpret that they had evidently before their minds the free course within the body of an existing vital fluid. It is needless to multiply instances of old and absurd doctrines; but it suffices for our present purpose to say that the ancient Hindus started in their practice of medicine with an attempt to base their treatment on anatomical truths.

Materia Medica, or that portion of medicine that contains the preparations and uses of mineral and vegetable substances, in a remote antiquity, had been cultivated to a greater nicety. Every substance that forms the articles of food had been treated separately, with a view to the determination of its dietetic as well as therapeutic qualities, although anything like chemical analysis was not known in those ancient times. Substances were denominated as hot or cooling according as they were more compact, or contained more or less water in their constituents, or were more indigestible when a quantity of them was ingested into the system. Thus, to cite examples—rice was considered more cooling than wheat-flour, succulent fruits than almonds, or milk than pea-soups. Vegetables, as a rule, were looked upon as more

digestible than animal substances, and hence you find general consumption of a diet that abounds in so much starchy principles. In chronic diarrhœa and dysentery, where the digestive power of the system is reduced to the lowest ebb, they regulated their regimen by allowing milk and rice in exclusion of other dietaries. On the contrary, in prolonged convalescence from fever you will observe a Hindu physician scrupulously abstains from allowing milk and rice, on the erroneous belief that whatever is cooling tends to the accumulation of phlegm in the system, and adds fuel to the proximate cause of febrile distempers. Of the mineral substances, sulphur, borax, iron, mercury, copper, silver, gold, arsenic, and antimony were most in vogue. In fact, there is not a compound of reputed efficacy whose value is not masked by the addition of gold dust as one of its ingredients. Whether it was to the entertainment of a strange hypothesis that the efficacy of a compound increases in proportion to its value, or, in other words, to the supposed belief that valuable metals are most potent in their effects, I am not in a position to explain. Great has been the curative power imputed to these mineral substances, and some of them, I am afraid I must say, are only inert. Iron, in the form of sesquioxide, formed the principal ingredient of the compounds em-

ployed as tonic and febrifuge; although ashes of burnt pearl, which are nothing better than impure carbonate of lime, and gold dust, were added to increase their value and effect. Though gold, as a metal, is insoluble in the gastric juice, and hence probably passes out of the system unchanged, yet I am forced to the belief that some of their compounds are not without their beneficial actions. For often under their influence I have witnessed instances of recovery from chronic intermittent fever, when a prolonged trial of quinine and iron had failed to bring on the desired effect. Mercury and sulphur form compounds which were prescribed in most of the diseases, and yet, when we observe that such substance in pharmacopœia was not considered as eligible for internal administration, we cannot but be struck at the discrepancy. In chronic dysentery it formed their invaluable remedy, and, given in small doses, I believe it acts as an alterative without bringing on any salivation. Arsenic enters into the ingredient of all their remedies for intermittent fever, and yet it is only of late, in the western world, that its efficacy has been acknowledged. Most other remedies are obtained from the vegetable kingdom, and some of them, I am glad to observe, have found their place in the British Pharmacopœia; whilst others, though not official, are extensively used

in India as substitutes for European drugs. The most important of them, I may mention, are Bael Chiretta, Mudar, Ununtmool, Russut, Goolunch, Neem Kurchee, Kamella Kalladauna, &c. Hundreds of them yet remain unacknowledged in the British Pharmacopœia, and will, no doubt, amply repay the patient research of an inquiring mind, that, unshackled by fetters of prejudice, boldly advances to divulge nature's mysterious treasures. It is true that in an undertaking such as this, you will have to search for a grain of substance amongst bushels of chaff; but that consideration does not deter a pearl-diver from fathoming the depth of a perilous sea, and jeopardizing his life for a chance which too often he knows may prove unsuccessful. And yet, do we not sometimes see him come up to the surface of water with a handful of shells, one of which may contain the pearl for which he cast his lot? With the illustrious lives of Hunter and Simpson before us, are we to be told that the profession cannot boast of members that can command more patience and forbearance to insure success? To trace the source of the Nile will certainly be a gratification of human vanity; but will it confer on humanity half the inestimable boon which the discovery of a yet untried drug may lead to? Sir Thomas Watson has well expressed in his lectures on the principles

and practice of physic, the opinion that nature in her bounty has blessed every soil with the drug for the disease that is endemic in the land. Are we then to believe that India, noted for fertility and exuberance of its vegetation, still lacks those important plants that stave off the onsets of pestiferous maladies that sweep over the length and breadth of the soil; that the Almighty, in his providence, has not blessed the country with the products that pertain to the well-being of our life and health; and that, had it not been for the British Pharmacopœia, India would have been long decimated of her population, and her history told in the annals of antiquity as a nation extinct on the face of the earth?

Apologizing for the digression, let me draw your attention to the fact, that there are in use amongst the Koberajes or Hindu physicians many vegetable substances that are well worth trial. I have seen patients recovering from an advanced stage of lung disease when pronounced by European surgeons as past recovery. Call it the Vis Medicatrix Naturæ, or the nature's mode of cure. The general belief amongst the people is strong on the point that the Indian Materia Medica contains some remedies really beneficial in intestinal and pulmonary complaints, and that, if methodized by experiments and sound reasoning, they may vie

in efficacy with the most potent drugs in the British Pharmacopœia that are now in daily use amongst us.

The practice of medicine as found among the ancient Hindus consisted of two parts, one teaching of symptoms called Needan (nosology), and the other of the treatment of diseases, Ayoorbed (therapeutics). The symptoms are described with a detailed exactness approaching to perfection; but, if it is a theory to expound or an explanation of a phenomenon, there the incorrect statement betrays their mysterious and ignorant views. Yet as much empiricism as can advance the interest of the science was by them attained, and that it was not a small one you can judge, when we may say that the present science of medicine owes much of its advancement primarily to pure empiricism. The plan of treatment adopted by them was analogous to the anti-phlogistic type, in which, however, the fire was quenched, not by the rapid withdrawal of already-existing vital fluid in the system, as by bleeding or by leeching, but by the slow stoppage to the supply of that fuel which keeps up the combustion. Starving the patient was their main feature in treatment, and nature was more trusted to in those days of simplicity. I cannot give you a better idea of their practice than by reciting the treatment of fever as adopted by them in acute

cases. For first forty-eight hours the patients are left without medicine, in order, as they would say, to allow the bile and ill humour to consume themselves. After two days, during which period the patient is allowed a very low diet, consisting of a scanty burnt paddy and a still more scanty supply of hot water for drink, then an infusion of ten drugs, consisting of a mixture of bitters and purgatives, is administered till the fever subsides. If the fever still persists, pills, the active ingredient of which is white arsenic, are given internally in divided doses; and this, in conjunction with the starving process which they strictly enforced, did rarely fail in subduing fever of ordinary intensity within ten days—with much detriment, however, to the constitution of the patient. During convalescence the diet is regulated for at least a week by the physician, and is limited to certain soups and vegetables only. If the patient shows any symptom of prostration and delirium, which are too often symptoms of exhaustion of the system, stimulation is attempted by the administration of remedies which are reputed poisons, as snake poison or the poisonous root of aconite. Sometimes some acrids are blown into the nose by means of quills, and whilst the delicate sensitive mucous membrane forms a nidus for absorption of the active ingredient, indirectly it stimulates the heart to more

vigorous contraction, probably by irritating the zone of nervous filaments according to the well-known law of reflex action in medicine. That often such means come to our happy relief will be told in the instance of a patient whose life was saved from a state of hopeless lethargy by resorting to this nasal irritation, when life was well nigh threatened to be extinct. It was at that time a happy hit to try tickling the nose with a feather when all the other reflex surfaces were nearly exhausted, and we had the satisfaction for the first time to observe the patient move her limbs. Restoration to consciousness soon followed, and thus a dead feather hastened her recovery, if not brought her into existence. Can we, with such a case before us, deny altogether the fact of the efficacy of this peripheral irritation of a sensitive organ by powerful acrid substances, which at the same time influence the system secondarily as a diffusible stimulant? The practice seems to me no more novel in its idea than the holding of ammonia bottles to the nose of a patient for reviving the feeble vitality of a frame; and yet how little is it utilised in cases of sudden depression, when a highly sensitive organ requires to be sharply attacked to turn the balance of flagging energies in favour of life, as in death from chloroform, and other allied instances. In chronic

dysentery, with general dropsical condition of the limbs, their method of treatment consists in entire refrainment from salt, and water for drink, and persisting in a course of regimen consisting exclusively of milk and rice for a period of forty-one days. The medicine given internally is either a preparation of black sulphuret of mercury with gold, or pills containing sulphuret of antimony, red vermilion, borax, and opium, as principal ingredients. If the patient cannot entirely abstain from water, milk of cocoa-nut is cautiously substituted, for it is asserted that the efficacy of the treatment is entirely dependent on the abstinence from water and salt. It is strange that most of the cases not only recover, but the patient's health often improves to an amazing extent, without any subsequent mercurialization. I wish not to theorize on the *modus operandi* of the remedy, nor do I justify the indiscriminate adoption of an empirical plan; but what I request you to bear in mind is that, how far the plan tallies with the sound reasonings of the present period when we advocate refrainment from water in general anasarca, and enforce a similar milk diet in dysenteric complaints. Diseases of the skin were attributed to corruption of different humours in the blood, and the contagious nature of leprosy and the necessary observance of segregation of such patients as social

outcasts, which they religiously enforced, remains *still* an enigma in the present advanced state of the profession.

The science and art of surgery were very little practised in those olden times, for, depending for their advancement on the talents of the uneducated and ignorant portion of the community, as the barbers, they retained their primeval state of immaturity, and comprehended only a few minor operations, as opening an abscess, cupping, bleeding and applying moxas, and actual cautery; yet, for ages past, we find records of operations for cataract performed by lower classes, by means of needles, which at the present moment goes by the name of operation by depression. Their skill and agility in performance were looked upon as wonders by the people, and even now in India we find a group of fakeers, under the pretensions of miraculous power, professing their surgical skill, nay, thriving in the face of English practitioners, most of whose singular backwardness in this delicate operation in India has given countenance to their vaunted charlatanism.* Their cupping apparatus consisted of a cow's horn evenly cut off at the base, and bored at the apex with knives for

* The frequency of stone in certain districts led them to the investigation of a method for its extraction which consisted in hooking the stone with two fingers introduced into the rectum, and cutting down upon it by a common knife.

scarification. Exhausting air by sucking caused necessary vacuum, and the quantity of blood was regulated by the number of applications of the horn each time. Bleeding was performed by opening superficial veins in the calves of the leg; and in a peculiar disease called Nukra, consisting of local inflammation of the mucous membrane of the nose, attended with fever and headache, the common practice was to thrust a needle point in the median septum of the nose, and produce topical bleeding. Moxas were frequently resorted to, to serve as counter-irritant in enlargement of spleen or liver, on the same principle as we now apply blisters or other irritant ointments; and it is not an uncommon sight to observe in malarious districts pot-bellied children with scores of such marks on the abdomen, to bear witness to posterity of the existence of a rude surgical practice of their ancestors.

Although hygiene, or the principles of sanitation, have only of late come to be understood by the medical profession, and have received the attention it so worthily deserves, it has long been advocated in the Hindu system. To ward off an attack of a disease seems more conservative in its principles than to extinguish a flame when the conflagration is at its height. With what knowledge of sanitation the Hindus professed, they had mixed up

their religious rites, and they enforced the observance of them with threats of penance. There cannot possibly be conjectured a more salutary injunction to the natives of tropical India than daily ablution of the body in a running stream; and do we not observe the same as consisting of a portion of the daily work of a Hindu, forming the preliminary of his divine worship? To secure the object in view, the waters of the Ganges have been sanctified, and it is said that immersion of the body in the holy river washes away the accumulated sins, so that the hope of salvation, if not the desire of cleanliness, may induce the superstitious mass to try the benefit of a bath. Pork and beef form the forbidden dietaries of a Hindu; and whilst we look on the one hand to the filthy habits of the former animal in its living state, and the various parasitic diseases that its meat creates, and on the other to the great utility of the latter in domestic purposes, assisting in the tillage of the ground, and affording the delicious milk which forms the sole nutritive regimen of a Hindu, we cannot too much admire the administrative genius which, years ago, enjoined their strict abstinence. Dry earth has long been in vogue for removing bad odour, and since its efficacy has come to be recognised, it has been universally adopted in every jail as dry earth conservancy system. In

chronic obstinate diseases, pilgrimage to a sacred and distant land is inculcated. You can easily imagine what effect such a change of climate, acting on the simple belief of a prejudiced mind, will have in the cure of otherwise unmanageable distempers. But with all this, the sanitary arrangement of a native sick-room betrays ignorance in fundamental principles of hygiene, and constitutes the conditions which surely thwart the natural process of recovery. If you are to put before a Hindu the alternative of poison or pure air, he will denounce them both as coming under the same category. You can hardly conceive a worse hot-bed of diseases than the tainted atmosphere of a Hindu's sick-room, with every chink or hole scrupulously blocked, and the doors and windows kept constantly fast; and although the custom is gradually being abandoned, yet you often observe many a grandmother, doting on her customs of fond old times, defying the injunctions of physicians for fear of letting in an evil spirit to visit her darling along with the wind. But the management of women after confinement in India forms the finishing stroke of absurdities and ignorance. The mind revolts to dwell on such a tragic scene, which displays nothing more than brutal heartlessness and want of sympathy of men towards their opposite sex.

At a time when the violent struggles of nature reduce the strength to the lowest ebb, when the storms of the pains of labour threaten to upset the feeble bark of humanity, when the long-continued agony longs for a cheering and consoling word from those that are near and dear unto her heart, at the critical moment when life seems to waver between the present world and eternity, imagine the condition of the mother and her state of mind when, put out in a wretched apartment in one corner of the house which is looked upon as profane and impure, she is doomed to pass her days absolutely in the company of an ignorant midwife for a fortnight before she is considered accessible to the company of her relatives. Cut off from society, and even from the luxuries of life, it is a matter of surprise how Hindu mothers do not often succumb to over-exhaustion and despondency. I have put this fact in a prominent light with the earnest desire to have this mischievous system eradicated, for I eagerly look for the day when the spirit of emancipation of Hindu women will be directed to remedy this monstrous evil, which still reigns paramount in our country.

Thus I have feebly attempted to sketch the nature of Hindu medicine as it was from ancient time previous to the British conquest, and to some

extent descended to the present day. As we are aware, more than a century ago a band of Englishmen, under the chart granted by Queen Elizabeth, landed in India with the express object of carrying on commerce. How that small company gradually strengthened and grew in power, till it absorbed the whole country in its powerful grasp, I leave for the history of British India to speak. Suffice for my present purpose to state that the commission to trade in the interior was obtained from Shah Jehan through the influence of Dr. Broughton, a medical man who attended the emperor's daughter when she lay in a precarious state from the effect of a severe burn. We observe, then, that the *first foundation-stone* of the present *British Indian territory* was laid, not by the heroic valour of a Clive or a Hastings, not by the conquest of bloody battles, but by the *godlike influence which medicine* carries with it wherever it goes. I have exalted it with the epithet godlike, for do we not observe CHRIST, in the latter part of his days, gaining the good-will of his people, and securing their allegiance by the exercise of that *healing skill* which always accompanies the qualifications of an inspired prophet? Oh! ye who hold the view that India should be governed by strength of arms, and uncharitably protest against the diffusion of education, look up to instances of self-obedience, wherein

dwelleth not the dread of kings, and pause before you again consign the educational system to a wholesale denunciation.

It was not until the year 1836, under the auspices of Lord William Bentinck, that the first proposal for the diffusion of English medical knowledge amongst the native populations was entertained. The success which attended the establishment of English schools and colleges had impressed the authorities of the intellectual capabilities of a Hindu, and vigorous exertions were set forth to the inauguration of a medical college to bestow gratuitous instruction. Great was the agitation amongst the community to oppose this laudable plan, which threatened to shake the foundation of their religious principles, and the difficulty in the way of obtaining students to enlist themselves in the profession was not by any means inconsiderable at the onset. Students with a very superficial knowledge of English were received, scholarships awarded to each, and books and dissecting cases were provided. Still, the number did not exceed ten. With dry bones and dissection of goats, anatomical instruction was imparted, till the necessity for human dissection came to be urgently felt. The young Hindu minds shrugged their shoulders and kept themselves aloof from such revolting proposals, when one of them dis-

tinguished himself by becoming the champion of the rest; he was a man of Voydos (*physician*) *caste*, named Modoosoodna Goopta. Long may that period be remembered, when he, with scalpel in hand and with a beating heart, first overthrew the base prejudice that enthralled the Hindu minds and cleared the way of those obstructions that were stumbling-blocks to the true progress of science. Long may his name be remembered by our nation with gratitude for paving the way to the attainment of that science which has extended its boon to millions of India's population! His portrait has been placed in the theatre of the Medical College in honour and commemoration of his commendable deed.

A small dissecting-room was erected, with high surrounding walls, and guarded by the police to prevent an outrageous assault from the people, who often used to give vent to their feelings by pelting stones from outside the palings. Ridiculous rumours were set afloat to detract the reputation of the institution, as of children being kidnapped and sick persons killed to furnish bodies for dissection. When once the ice is broken, there stands no barrier, however strong, that can withstand its resisting influence. Soon a regular college was established, and candidates by numbers flocked under its banners. A small hospital and

outdoor dispensary at first imparted necessary practical instruction, and the class of men that graduated from the college were embodied under the name of sub-assistant-surgeons. They were dispatched to different places in charge of hospitals, under the guidance and supervision of European medical officers, and the way in which they discharged their duties fully justified the expectation which was entertained of them. The number of hospitals increased throughout the country, and the necessity for these institutions became more urgent. They had to cope with many difficulties in their practice in spreading the benefits of English treatment, and to them is due in a great measure the gradual abolition of those absurd customs of *inoculation* and of placing implicit reliance on the powers of incantations of the priests in diseases when life is in extreme jeopardy. Much advancement has been made in the way of making English medicine appreciated by the people at large, but much still remains to be done with regard to the ignorant mass, whose prejudice is often confirmed by old orthodox Hindu physicians, who find it to their interest to circulate the belief that most of the English medicines contain a mixture of *cows'* blood and *human* bone ashes—things held profane by the religion of the nation. With the augmentation of the number of candidates

for instruction their former privileges were one by one withheld, more branches were added to the curriculum of study, and to complete the whole, the institution was incorporated to the University in the year 1856. A schooling fee was fixed for lectures, and the College reckoned with it an hospital, with accommodation for about four hundred patients, built by contributions from the native and European community, that can vie in extrinsic splendour and in intrinsic management with all her sister institutions in the island. The instructions imparted are of the best standard, and the degrees now conferred are Licentiateship in Medicine and Surgery, and Bachelorship and Doctorship in Medicine. Only four candidates have up to this time passed their M.D., and twelve or fifteen each year come out as Licentiates and Bachelors. Some of these betake themselves te employment under Government in the subordinate Medical Department, whilst others set up in the country as independent practitioners. The course of education for Licentiateship approaches that for M.B. of London, and the Indian Medical Colleges are now affiliated with the University of London.

With a curriculum comprising two courses of lectures on Anatomy, Chemistry, Materia Medica, Botany, Physiology, and Comparative Anatomy in the first, second, and third years, and on

Medicine, Surgery, Pathology, Midwifery, Medical Jurisprudence, Ophthalmic Surgery, Hygiene and Dentistry in the fourth and fifth years, the course of instruction is not considered sufficient to entitle one to English registration. The examinations are conducted so strictly, and the questions set by the examiners are so stiff, that I take the liberty to challenge any student of the British Universities to pass them with tolerable ease and confidence. Is not the staff of professors drawn from the *élite* of the Indian Medical Corps that can boast of a Sir Ranald Martin, a Murchison, a Chevers, a Goodeve, a Fayrer, a Morehead, and a Carter? One fact remains undeniable, that out of a score of medical men that have gone from here for English diplomas, not *one* instance can be cited where they have failed to acquit themselves creditably, although most of them underwent no special course of education in England for preparing themselves for the trial. Is not India a British settlement, and are not the Indians British subjects? Then why should they be deprived of the privilege to which a portion is entitled? A time there was when such questions could not have been entertained; but as year after year throws new light, disclosing the rapid stride of advancement which the people of India are making in the way to civilisation,

injustice ought no longer to be sustained. The objection of insufficient preliminary training is often put in the way; but I may venture to remark that, barring Latin from the curriculum, the standard in other branches equals, if not surpasses, the standard for similar trials in the University of London. Sanscrit is as much a difficult branch to the Indians as Latin is to the English pupils, not to include the disadvantage of the English tongue, which is altogether foreign to us. It is ridiculous to enforce the ignoring of our University degrees, and preferring licences granted by some examining bodies in Great Britain that hold by no means a position superior to the Indian Universities in status and standard. I respectfully solicit the medical profession in England to weigh the question that I have mooted, inasmuch as it will be conferring on India a benefit for which she will be thoroughly grateful.

Thus we have at present broadcast in India three sets of native medical practitioners—1st, Those that are duly qualified and educated in English, practising English medicine; 2nd, Koberajs or Byeds, practising old Hindu system; and 3rd, Hakeems, or Mohammedan physicians, whose history I have refrained from tracing. Besides, there is a band of lawless resolutes,

whose prototypes we observe in quacks and empirics. These infest the country like locusts, and cause more devastation amongst humanity than the diseases which they pretend to combat. Nothing is more easy in India than to become a quack practitioner. If there is a lowest drudge who finds his work disagreeable—if there is a clerk whose dull head finds no employment for support, or if there is a barber's son whose ambition does not like to remain confined within the narrow limits of his ancestral calling—medicine becomes the refuge of each and all, and in place of an axe or razor, you find them handling bistouries and lancets, which are no more congenial to their intellect or skill than the cold metal which betrays their former avocations. These impose on the ignorant peasantry, and play with human lives as trifles, whilst the Authorities offer no safeguard to the uneducated mass from their havocs in the shape of medical registration. The human body in disease is like a storm-stricken barque that requires an experienced pilot for its safe mooring, whilst an inexperienced hand, unknown to the position of shoals and treacherous rocks, drifts it ashore, and makes shipwreck of a valuable life which might easily have been saved.

Besides these three sets of native practitioners,

we have two classes of English medical men called the Covenanted and the Uncovenanted. The former hold charge of civil stations, and have sometimes under their supervision a sub-assistant surgeon, or a subordinate of lower standard, known as native doctors. The Covenanted are sent out with commissions after the competitive examination held twice in a year, whilst the Uncovenanted are drawn up partly from that body of men who, after taking their qualifications in England, venture their chance in the East for lucrative interests, and partly from a class named Apothecaries. *Apothecaries in India signify anything but a tolerable knowledge of medicine.* They rise from a compounder or stewardship to be the medical officer in charge of a station, and thus, *being English*, without any previous medical education, occupy social positions higher than Native graduates of a University, and with more prospects and emoluments.

I have thus drawn a hasty sketch of the state of medical profession in India up to the present epoch and the progress it has made and is expected to make, under the auspices of British rule, although, through some radical defects in the constitution, the science has not received its due share of attention from my countrymen as it deserves. The spirit of scientific research is in direct proportion to the

advancement of civilisation in the land, the perfection of one being a step in advance to the attainment of the other. How the knowledge of the properties of heat, air, steam, and electricity has subserved to promote our domestic comforts, and how much has the science of medicine contributed, not only in teaching us how to live but how to enjoy that life, by laying out the principles of sanitation! Such is the power of health that, without it, all other enjoyments fail to bring us happiness. The gouty noble reclining in his lordly mansion cannot half as much enjoy the pleasures of his life as the healthy rustic who earns his bread by the sweat of his brow. Is it not incumbent on us then, that a science that teaches us the very source of comfort should be cultivated with more earnestness and success? The question brings us to the last portion of our subject, viz., the means calculated to promote the status of medical science in India. Without a proper preliminary training it is impossible to grasp a science and to gain the mastery over it. Our common sense may enable us to understand our broad principles, nay, even turn them to use, but for any step of an inventive nature more than this will be requisite. Whilst agreeing in the main with the medical council for the necessity of making medical education easily accessible to the generality of the people, I cannot help expressing that the

means proposed for the end of fixing for it a low standard of preliminary training will be detrimental to the higher expositions of truth. A higher class of preliminary education ought to be enforced in *every country*, and every facility and opportunity given to the subsequent exercise and display of inquisitive faculties. Let the prospect of the profession be enlarged, so as to induce the good and intelligent members of the community to enlist themselves in it, and let the Government show encouragement to them in the way of appreciation of their merit. Thus followed out, it will not be long before India will contribute her quota of medical research. As long as the profession does not rise in the estimation of the public, can any advance be expected? It is narrow political economy in strong contrast with the spirit of the age, to bring forward the law of supply and demand to bear on the question of improvement of status of a profession; and whilst on one side of the world we see gradual concessions are being made to *enlarge the prospect of poor-law medical officers*, may we not entertain a sanguine hope that the time is not distant when the same necessity will be felt for the medical profession in India? But where to find the man who, divesting himself of party prejudices, and conscientious in the discharge of his duties to God and to his fellowmen, should

come forward to remove the stigma laid at the door of the British nation? If it be true that England does not sway India for her own benefit, but for the good of the children of the soil, let her extend the boons in equal terms to all her subjects, irrespective of colour and creed. If it be true that Christianity does not embrace, in its broad Catholic signification, the narrow spirit of race prejudice that keeps out one nation from another, then down with the party feelings and race antagonism that have been bane to India's prosperity. It is not that there is wanting a party of true Christians to advocate Indian cause; but, oh! for the day when distinctions of colour will cease to influence the minds of human races, and each acknowledging the fatherhood of one Creator, will shake hands with the other in the spirit of brotherhood and equality. With all the knowledge of physiology before us let not the degree of variation of superficial tint form any longer a hindrance to the mutual exchange of our sympathies. Oh! do not leave us to cry out with the bronzed prince of Shakespeare:—

> "Mislike us not for our complexion,
> The shadow'd livery of the burnish'd sun,
> To whom we are neighbour and near bred."

ON THE

SOLVENT ACTION OF PAPAYA JUICE ON THE NITROGENOUS ARTICLES OF FOOD.

BASING my experiments on the strength of a popular belief in India, I have arrived at results which are well worth recording. These beliefs, though originally started and practised upon by the ignorant mass, are often pregnant of wholesome truths. To ignore or overlook them altogether is detrimental to the progress of science. For it was upon the evidence and experience of an ignorant body of milkmen that Dr. Jenner brought to light the protective influence of cow-pox in the human system.

It is the practice amongst the native cooks in India to add a few drops of the milky juice of the plant under consideration to tough old meat, to make it tender and supple. Four years ago, anxious to ascertain whether any such virtue really existed in the plant, I added a few drops

of the fresh juice to a pound of minced goat's meat, and stewed it over a slow fire. To my surprise, the whole ran into a diffluent mass in five minutes, owing to a larger quantity of the juice having been used on the occasion than is necessary to make it tender and eatable. Since then I had no further opportunity to test its property until I went to England, when I carried with me a quantity of the juice obtained by incising superficially the unripe fruit, and drying it in the sun. Through the kindness of Dr. Parkes, the esteemed professor of Netley, I was allowed the opportunity to carry on the experiment.

The plant belongs to the natural order Papayacæ, and is termed Carica Papaya. It is indigenous to tropical climates, and has a rapid growth, consisting of an unbranched stem from ten to twelve feet high, surmounted by large, deeply palmated stalked leaves. The fruits or pepos are edible both in their ripe and unripe state. The former is used as dessert, and the latter cooked as vegetable. The fruit is about the size of a melon, with a green rind, enclosing a sweet, delicious pulp, in which innumerable seeds, about the size and appearance of black pepper, are imbedded. The plant grows extensively in Bengal and over all India, and bears fruit in one year.

Incisions on the stem, or breaking off the leaf from its joint, yield a few drops of this milky juice, but an abundant flow of it can be obtained by scarifying the unripe fruit in the same way as the poppy capsules are treated. The fluid is liable to decompose, especially in hot weather, if kept over for a few days, and hence it should be dried in the sun in shallow dishes, and stored for use. One ounce of the juice can be obtained in an hour's time from the fruits of the vigorous plant. The dried stuff is of a yellowish white colour, hard, friable, and has a peculiar smell. Two drachms of this beaten up with one ounce of water will, I believe, give the approximate proportion of strength of the original liquid. At the risk of being tedious, I will give the details of the experiment as they were noted down at the time.

April 30th.—thermometer 66 deg.—The juice was obtained on 20th December, *en route* to England. A solution of it was made of the strength of 1 gramme to 3 c. c. of distilled water. Two pieces of fresh lean of beef, each weighing ten grammes, were taken and finely minced. Whilst to the one 10 c. c. of distilled water were simply added, to the other 1 c. c. of the made-up solution was mixed up with 9 c. c. of distilled water and added also. Both cups

boiled for five minutes. The medicated portion became soft and half dissolved in the fluid, whilst the other dish remained tough and unchanged.

Another piece of the same meat, of the same weight, was moistened in lump with 1 c. c. of the solution, and kept over for next day's observation.

1st May.—The superficial portion of the lump was soft and gelatinous, making the piece very slippery to the touch. When cut up into pieces, and a little more water added, the whole became pulpy in an hour's time, without the aid of heat.

The animal was killed on 28th April, the thermometer standing at 66°.

Another experiment which was made the same day to confirm the result was equally successful.

Two of the cups, medicated and unmedicated, were kept under cover by Dr. Parkes, to note whether the solution had any power to retard decomposition.

2nd May.—Decomposition had commenced in both the vessels, but it was more advanced in the cup with papaya solution.

27th May.—A fresh solution was made (1 gramme to 20 c. c. of water), and the following experiments were tried :—

In four separate dishes, beef, hard boiled white

of egg, freshly prepared moist, gluten and arrow-root, each 10 grammes in weight, were treated with 2 c. c. of the solution by 8 c. c. of distilled water. To make a standard for comparison, the same articles, of similar weight, were digested in four more dishes, with 10 c. c. of distilled water only. The whole kept over till next day, without heat.

28th May.—The dish of meat with papaya soon became gelatinous on being stirred with a glass rod. The albumen of egg was soft, and when mashed, broke into a uniform pulp. The gluten specimen was soft on the surface, and its superficial layer dissolved in the fluid, giving it a slight turbidity. Arrow-root was dry and visibly unchanged.

The dishes with water were unaffected. The meat fibres remained without change. The egg, when broken up, remained lumpy. The gluten was clear, and even when it was worked up with finger, did not give the liquid the least turbidity. Arrow-root dish was moist, but without any change.

It should be remarked that the dish of meat and of albumen contained more fluid than the corresponding ones with water, whilst the arrow-root dish, which was unaffected in both instances, was dry in one and moist in the other.

All the dishes were preserved for further test.

29th May.—Both the dishes of meat were eaten away by a cat, which grew exceedingly fond of it. The whole of the gluten was dissolved in the solution, whilst the dish with water was yet unchanged. Each of the cups was mixed up with 50 c. c. of distilled water, and left over for next day.

30th May.—The cups filtered for test. The two arrow-root solutions gave no reaction when tested with Fehling's Solution for sugar.

The drugged albumen was fast undergoing decomposition, and had an offensive smell. When filtered, nearly the whole of it passed through. The filtrate was clear and decidedly acid. It gave no precipitate with heat, or heat and nitric acid, or ferrocyanate of potash.

The watery specimen of albumen, when filtered, left behind a quantity of residue. The filtrate was milky in colour and neutral in reaction, and gave a slight precipitate with each of the reagents.

The specimen of gluten solution in papaya passed through the filter, leaving merely a trace behind. The solution was tolerably clear and acid, and gave an abundant precipitate with heat. More than $\frac{1}{4}$ was coagulated with heat and nitric acid, and some flocculi formed with ferrocya-

nate of potash. The precipitate, with heat, was insoluble in liqr. potassæ.

In the watery dish of gluten very little was dissolved. The lump was still sticky. The water solution was clear and strongly acid, and gave no precipitate with any of the reagents. Nitric acid made the solution clearer than before.

3rd June.—Solution of the strength of ½ gramme to 10 c. c. of water. As this was kept over for some days before use, it was found to have lost its acid reaction, and settled itself into two parts—the clear liquid above, and a sediment below. The clear supernatant liquid gave the same reaction with a piece of meat, showing that the solvent agent was soluble. A standard preparation of meat with water was made at the same time.

5th June.—Both the dishes were mixed with 50 c. c. of water, and left to filter through.

8th June.—The papaya dish was somewhat advanced, whilst in the watery dish there was no sign of putrefaction. 10 c. c. of the papaya filtrate was dried in a porcelain crucible in a hot air bath, and 10 c. c. of the watery filtrate was treated in a similar way. The quantity of solid dissolved out in the papaya filtrate weighed 2 grammes, whilst in the watery filtrate it was ·09 grammes.

Another equal quantity of each filtrate was tested in a test tube with heat and nitric acid, and it confirmed the result that the albumen dissolved out in one was more than double the quantity in the other.

A piece of gelatinous meat, as changed by papaya juice, was examined next day by Dr Welsch, under the microscope. It swarmed with vibriones in active motion. As for the muscular fibres, the disintegration was complete, and those fasciculi that were yet entire were just separating themselves into ultimate particles. The digestion could not have been more complete.

As very little solid stuff was left for further research, the remnant was reserved for chemical analysis.

A solution of the strength of 1 gramme to 30 c. c. of distilled water was prepared and filtered. Reaction distinctly acid. A portion was boiled to dryness in a crucible. The vapour did not redden litmus, but the concentrated solution became more strongly acid, and remained so when thoroughly dried. A little more heating charred the side of the capsule. When incinerated the ash gave an alkaline reaction. A deep precipitate on boiling. The coagulum was strained, and a portion treated with the

following reagents. Nitrate of silver gave a white precipitate soluble in ammonia and acids; no precipitate with chloride of calcium, cold or boiled; no change of colour with perchloride of iron; a white cloudy precipitate with liqr. potassæ; some precipitate with chloride of barium.

Remarks.—The above experiments in detail conclusively show the solvent action of the juice on all nitrogenous articles of food. Its effect in making the meat tender has been noticed in several botanical works, East and West Indian, but, so far as I have been able to find, no systematic experiment has been made up to the present to test its virtues medicinally. Some have contented themselves in merely mentioning the practice of the natives as alluded to above, and some West Indian authors ascribe to the plant the power of hastening decomposition in dead animals—so much so that they go the length to assert that a joint suspended under its branches will fall to pieces when cooked. Nay, the belief in the West Indies is so strong, in its power of hastening decomposition, that it is said that live animals fed on the unripe fruit will not keep long after death.

That there is a considerable power of disintegration inherent in the plant is established beyond doubt and cavil. But the question is,

what is its peculiar nature? Is it chemical or dynamical? Is it, like the yeast, a fermenting agent, the presence of which in dead animal substances destroys the stability of their composition; or, are the solution and disintegration allied to natural digestion, and the results of chemical change? If the former, there is a valuable discovery of a nitrogenous ferment, which stands in the same relation to protein compounds as yeast does to starch. The conversion of insoluble starch to soluble substances constitutes the process of digestion of amylaceous principles of food in our mouth, and this conversion is chiefly assisted by an animal ferment, Ptyaline, that exists in saliva. The digestion of nitrogenous principles is mostly a chemical process, in which the gastric juice plays an important part. The rapidity and completeness with which the papaya juice acts on meat, when aided by high temperature, surpasses all digestive processes on record. The smallness of quantity used to bring about the change negatives the assumption of any caustic virtue in the plant. Besides, I have put the juice on my tongue, and applied it to the skin without any irritant effect. I was at first inclined to believe the solvent action as due to some fixed organic acid, either tartaric, citric or malic, as will be seen from the records of analysis, but

I have failed to arrive at any determined result. The disintegration takes place too soon to be the effect of mere putrefaction. The moving vibriones observed under the microscope were no doubt generated by keeping, and were not the cause, but the effect of disintegration. In all putrefactive changes these are looked upon as the initiators. But inasmuch as the boiling temperature which destroys the existence of vibriones hastens this peculiar change, it is fair to suppose that the solvent action is something different from putrefaction. Besides, no reagent has yet been able to bring about putrefaction in fresh meat, in five minutes. The fruits in their ripe and unripe state are edible and quite harmless.

The digestive agent is not acid, for its reaction is too feeble, and even when long keeping makes it ammoniacal and neutralizes the acidity, it yet retains its peculiar virtue. The solvent principle is soluble in water. Coagulated albumen dissolved by it will not coagulate again with heat acquiring the property of albuminose; gluten is thoroughly dissolved, and can be re-precipitated.

The whole action is so identical to healthy digestion that I wonder we have not availed ourselves of this medicinal property, in cases of invalids and dyspeptics, to substitute a process of artificial digestion.

A few grains taken immediately after a meal will substitute the power where it is wanting. I have not tried it in any case internally, but from its effects on the cat, which grew so fond of it that it became a task to prevent its depredation, I believe it is harmless. My attention was also directed to discover whether it could be utilized in preparing soluble meat or something like a liquid extract, but its liability to decomposition is a bar to its use. Further investigations are yet wanting to establish its repute, but, as far as they have been gone into, the result is highly encouraging. I intend to resume my operations as soon as I am relieved of my present arduous werk, which leaves no time for experiment.

THE END.

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